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ERRATUM

On p. 168 the title of the new chapter should read *Sycoecinae* instead of *Sycoryctini*.

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INHOUD

- B. AUKEMA. — A survey of the Dutch species of the subgenus *Hylopsallus* of *Psallus* (Hemiptera-Heteroptera, Miridae), p. 1—25, figs. 1—36.

A SURVEY OF THE DUTCH SPECIES OF THE SUBGENUS *HYLOPSALLUS* OF *PSALLUS* (HEMIPTERA-HETEROPTERA, MIRIDAE)

(Mededeling EIS-Nederland, no. 6)

by

BEREND AUKEMA

Instituut voor Taxonomische Zoölogie, Amsterdam

With 36 text-figures

ABSTRACT

The Dutch material of the subgenus *Psallus* (*Hylopsallus*) and of the related *Asthenarius quercus* (Kirschbaum, 1856) is extensively revised. The occurrence of *Psallus* (*Hylopsallus*) *perrisi* (Mulsant, 1852), *P. (H.) variabilis* (Fallén, 1829) and *A. quercus* in the Netherlands is confirmed, whereas *P. (H.) wagneri* Ossiannilsson, 1953 is recorded now for the first time from this country. It is shown that measurements of external morphological characters do not allow identification of the species, as is suggested in most keys of *Hylopsallus*. Of the Dutch species and *P. (H.) assimilis* Stichel, 1956, which may be expected, a key to the males, descriptions, and drawings of the male genitalia are given, and the distribution of the Dutch species in the Netherlands is figured. Finally the status of *P. (H.) wagneri* is discussed.

INTRODUCTION

The genus *Psallus* Fieber, 1858, belongs to the subfamily Phylinae Handlirsch, 1925, tribe Phylini Douglas & Scott, 1865. The subgenus *Hylopsallus* was established by Wagner in 1952, and in the same publication *Psallus variabilis* (Fallén, 1829) was designated as the type of the subgenus.

The Dutch species of *Hylopsallus* are characterized by the pale antennae (base of segment 1 more or less dark), the black, dark-brown, red-brown or red body, the dark-brown or red femora, which are pale only at their extreme apices and either unspotted or provided with a few obscure dark spots beneath, the pale tibiae having dark spines arising from dark spots (at least at hind tibiae), the tarsal segment 3 being shorter than segment 2, the male genital segment, which is ventrally distinctly keeled, and the shape and processes of the aedeagus.

Wagner (1975) included 10 species in *Hylopsallus*, of which *quercus* (Kirschbaum, 1856) was transferred to the genus *Asthenarius* Kerzhner, 1962, in a later publication of the same author (Wagner, 1975a). Four of the nine species constituting the subgenus now are found in the Netherlands or adjacent countries.

Probably because the identification of the species of *Hylopsallus* is difficult without examination of the male genitalia, Dutch entomologists have paid little

attention to the representatives of *Hylopsallus*. Reclaire (1932, 1948) included *quercus* and *variabilis* in his checklist of Dutch species and Meurer (1956) added *perrisi* (Mulsant, 1852).

My unsuccessful attempts to identify some Dutch material of *Hylopsallus* led to this critical evaluation of all Dutch material of the subgenus available (cf. collections mentioned under Acknowledgements). Because *Asthenarius quercus* closely resembles *Hylopsallus* and since this species was often confused with *variabilis* by Dutch entomologists I have incorporated this species in the present study.

This study confirms the occurrence of *P. (H.) perrisi*, *variabilis* and *quercus* in the Netherlands, whereas *wagneri* is recorded from this country for the first time. Another species which could be expected in the Netherlands is *P. (H.) assimilis* Stichel, 1956. This species was described after material from England and was later recorded from West Germany (Rieger, 1975, 1976). Since *assimilis* was not found in museum material from the Netherlands, I have undertaken special efforts to find *assimilis* on its host plant, common maple (*Acer campestre* L.). However, all attempts were unsuccessful.

Furthermore my study of the Dutch *Hylopsallus* material led to a critical evaluation of the characters used in the literature for separating the species. The genitalia of all available Dutch males of *Hylopsallus* were dissected and examined. For reasons of comparison some Swedish material of *wagneri* and some British material of *perrisi*, *wagneri*, *variabilis* and *assimilis* was examined. A key to the males, drawings of the male genitalia and descriptions of the species are included.

TAXONOMIC CHARACTERS

The species of *Hylopsallus* have a very similar general appearance, although *perrisi* and *wagneri* are somewhat different in size and colour from *assimilis* and *variabilis*.

Absolute as well as relative measurements of external morphological structures are most frequently used in separating species of *Hylopsallus*. Especially the ratio of width of vertex to width of eye, the ratio of length of antennal segment 2 to length of segment 1, the ratio of length of antennal segment 2 to width of pronotal base, and the absolute length of the body including the wings are used in keys for the identification of species in *Hylopsallus* (Kerzhner & Yachevski, 1964; Southwood & Leston, 1959; Stichel, 1956, 1958; Wagner, 1952, 1961, 1967 and 1975; Wagner & Weber, 1964; Woodroffe, 1957 and Zaytseva, 1969).

However, precise measurements of great numbers of specimens show that these measurements do not provide a reliable basis for identification because of the great intraspecific variation and the great interspecific overlap (tables 1—3). All the keys mentioned are more or less misleading in suggesting the possibility of identification on the ground of simple measurements. The ratio of width of vertex to width of eye for instance is used by Wagner (1952, 1961, 1967 and 1975) and Woodroffe (1957) to separate *perrisi/wagneri*, *assimilis*, *variabilis* and *quercus* from each other. Comparison of their ratios with the ratios from my measurements (table 4) shows that their ratios do fall within the range of my measurements. On

Table 1. Measurements of Dutch specimens of *Psallus perrisi* and *P. wagneri*, males and females (n = number of specimens measured; r = range of measurements; \bar{x} = average of measurements; s.d. = standard deviation of measurements; c.v. = coefficient of variation).

	<i>perrisi</i>				<i>wagneri</i>				<i>perrisi/wagneri</i>						
	n	r	\bar{x}	s.d.	c.v.	n	r	\bar{x}	s.d.	c.v.	n	r	\bar{x}	s.d.	c.v.
length of body	122	3.06—4.04	3.55	0.19	5.46	27	3.21—3.78	3.55	0.15	4.10	71	3.02—4.06	3.59	0.43	11.98
width of body	117	1.24—1.68	1.44	0.08	5.74	28	1.19—1.55	1.42	0.15	6.40	69	1.30—1.69	1.53	0.07	4.48
width of head	139	0.69—0.87	0.75	0.02	3.31	29	0.69—0.78	0.75	0.02	3.18	81	0.71—0.81	0.76	0.02	2.80
width of vertex	139	0.32—0.43	0.35	0.02	4.50	29	0.31—0.37	0.35	0.02	4.75	81	0.34—0.40	0.38	0.01	3.36
length of ant. segment 1	127	0.19—0.25	0.22	0.03	12.49	28	0.19—0.24	0.22	0.01	6.00	80	0.20—0.25	0.22	0.01	4.64
length of ant. segment 2	125	0.81—1.03	0.93	0.05	5.15	28	0.86—1.03	0.92	0.05	4.98	80	0.81—1.08	0.97	0.05	4.89
length of ant. segment 3	94	0.40—0.62	0.53	0.04	7.04	10	0.50—0.55	0.53	0.02	—	77	0.47—0.63	0.55	0.04	7.55
length of ant. segment 4	61	0.25—0.43	0.36	0.03	7.94	8	0.33—0.38	0.36	—	—	61	0.30—0.43	0.36	0.02	6.92
length of antennae	59	1.71—2.20	2.05	0.10	4.80	7	1.95—2.17	2.04	—	—	61	1.79—2.26	2.10	0.09	4.51
width of pronotal base	129	1.06—1.39	1.22	0.06	4.70	29	1.03—1.29	1.19	0.06	5.28	79	1.08—1.39	1.26	0.06	4.58
length of body: width of body	117	2.18—2.92	2.45	0.13	5.29	27	2.28—2.83	2.50	0.13	5.02	67	2.20—2.56	2.38	0.08	3.56
width of vertex: width of eye	139	1.54—2.12	1.76	0.10	5.78	29	1.60—2.00	1.76	0.10	5.82	81	1.70—2.38	1.97	0.11	5.38
length of ant.: length of body	56	0.49—0.65	0.58	0.04	6.40	6	0.55—0.61	0.58	—	—	54	0.52—0.64	0.58	0.03	5.07
length of ant. segment 2: length of ant. segment 1	123	3.77—4.75	4.24	0.20	4.62	28	3.79—4.83	4.17	0.28	6.75	80	4.00—5.00	4.45	0.23	5.17
length of ant. segment 2: length of ant. segments 3 + 4	61	0.87—1.26	1.04	0.08	7.56	7	0.97—1.09	1.04	—	—	61	0.88—1.22	1.07	0.07	6.33
length of ant. segment 2: width of pronotal base	117	0.65—0.89	0.77	0.04	5.42	28	0.70—0.87	0.77	0.04	5.83	79	0.71—0.87	0.77	0.03	4.30
length of rostrum	7	1.21—1.33	1.29	—	—	—	—	—	—	—	22	1.34—1.46	1.42	0.04	—
length of rostrum: length of body	7	0.33—0.36	0.35	—	—	—	—	—	—	—	21	0.36—0.40	0.38	0.01	—

Table 2. Measurements of Dutch males of *Psallus variabilis* and *Asthenarius quercus* and British males of *P. assimilis*. As table 1.

	<i>assimilis</i>				<i>variabilis</i>				<i>quercus</i>			
	n	r	\bar{x}	s.d.	n	r	\bar{x}	s.d.	n	r	\bar{x}	s.d.
length of body	10	3.37—3.83	3.69	0.14	61	3.47—4.40	3.92	0.19	64	3.83—4.71	4.31	0.21
width of body	9	1.50—1.66	1.58	—	57	1.29—1.68	1.54	0.08	58	1.53—1.81	1.66	0.06
width of head	14	0.73—0.78	0.76	0.01	65	0.73—0.82	0.77	0.02	67	0.75—0.84	0.79	0.02
width of vertex	14	0.36—0.38	0.38	0.01	65	0.30—0.40	0.36	0.02	67	0.30—0.38	0.34	0.02
length of ant. segment 1	13	0.21—0.25	0.23	0.01	65	0.21—0.27	0.24	0.01	65	0.24—0.30	0.26	0.01
length of ant. segment 2	13	0.93—1.06	1.01	0.03	66	0.91—1.16	1.02	0.05	63	1.11—1.36	1.26	0.05
length of ant. segment 3	12	0.54—0.63	0.59	0.03	42	0.48—0.66	0.59	0.04	43	0.63—0.81	0.72	0.05
length of ant. segment 4	11	0.38—0.43	0.40	0.02	32	0.35—0.45	0.39	0.02	35	0.35—0.48	0.41	0.03
length of antennae	11	2.12—2.36	2.24	0.08	32	2.13—2.37	2.26	0.06	35	2.41—2.86	2.64	0.10
width of pronotal base	14	1.20—1.34	1.27	0.04	59	1.16—1.39	1.29	0.05	62	1.21—1.44	1.31	0.05
length of body: width of body	9	2.23—2.50	2.33	—	57	2.31—2.81	2.55	0.12	58	2.29—2.90	2.58	0.14
width of vertex: width of eye	14	1.90—2.11	1.98	0.08	65	1.39—2.16	1.78	0.13	67	1.30—2.00	1.47	0.12
length of ant.: length of body	9	0.55—0.63	0.60	—	32	0.53—0.64	0.58	0.03	34	0.55—0.69	0.61	0.04
length of ant. segment 2: length of ant. segment 1	13	4.00—4.71	4.41	0.23	65	3.60—4.78	4.23	0.23	63	4.24—5.38	4.89	0.24
length of ant. segment 2: length of ant. segments 3 + 4	11	0.95—1.10	1.02	0.04	32	0.93—1.14	1.03	0.05	35	1.04—1.26	1.11	0.06
length of ant. segment 2: width of pronotal base	12	0.76—0.84	0.80	0.03	59	0.72—0.87	0.78	0.03	58	0.87—1.06	0.97	0.04
length of rostrum	—	—	—	—	7	1.41—1.52	1.47	—	2	1.58—1.62	—	—
length of rostrum: length of body	—	—	—	—	7	0.35—0.39	0.36	—	2	0.33—0.36	—	—

Table 3. Measurements of Dutch females of *Psallus variabilis* and *Asthenarius quercus* and British females of *P. assimilis*. As table 1.

	♀ <i>assimilis</i>					♀ <i>variabilis</i>					♀ <i>quercus</i>				
	n	r	\bar{x}	s.d.	c.v.	n	r	\bar{x}	s.d.	c.v.	n	r	\bar{x}	s.d.	c.v.
length of body	24	3.52—4.04	3.73	0.13	—	68	3.28—4.26	3.85	0.19	4.84	53	3.52—4.32	3.88	0.21	5.51
width of body	18	1.53—1.71	1.64	0.06	—	64	1.30—1.77	1.66	0.07	4.26	53	1.48—1.81	1.65	0.07	4.01
width of head	29	0.73—0.81	0.77	0.02	2.96	73	0.73—0.83	0.79	0.02	2.28	58	0.67—0.85	0.79	0.03	3.30
width of vertex	29	0.36—0.42	0.40	0.01	3.47	73	0.36—0.42	0.40	0.01	3.33	58	0.35—0.42	0.39	0.01	3.23
length of ant. segment 1	28	0.21—0.27	0.24	0.01	5.42	73	0.23—0.27	0.25	0.01	3.15	59	0.23—0.28	0.25	0.01	4.72
length of ant. segment 2	29	0.96—1.06	1.02	0.03	3.00	73	0.91—1.16	1.05	0.04	3.82	59	1.06—1.31	1.21	0.06	4.73
length of ant. segment 3	24	0.55—0.67	0.61	0.03	5.07	70	0.52—0.69	0.61	0.04	5.95	51	0.61—0.86	0.71	0.05	7.52
length of ant. segment 4	20	0.38—0.45	0.41	0.02	—	61	0.35—0.44	0.39	0.02	5.69	34	0.38—0.58	0.42	0.04	9.44
length of antennae	20	2.16—2.41	2.28	0.07	—	61	2.17—2.51	2.30	0.08	3.65	34	2.34—2.90	2.59	0.12	4.61
width of pronotal base	28	1.13—1.41	1.29	0.07	5.38	70	1.11—1.45	1.34	0.06	4.32	56	1.16—1.44	1.28	0.06	4.40
length of body: width of body	18	2.15—2.43	2.27	0.08	—	63	2.12—2.62	2.33	0.09	3.79	53	2.06—2.73	2.35	0.14	5.75
width of vertex: width of eye	29	1.90—2.41	2.16	0.11	5.18	73	1.80—2.22	2.04	0.10	4.74	58	1.72—2.26	2.00	0.10	5.07
length of ant.: length of body	17	0.57—0.64	0.61	0.02	3.90	58	0.54—0.65	0.60	0.03	4.68	29	0.56—0.75	0.67	0.04	6.26
length of ant. segment 2: length of segment 1	28	3.76—4.71	4.28	0.23	5.38	73	3.85—4.60	4.21	0.18	4.37	59	4.18—5.33	4.85	0.23	4.84
length of ant. segment 2: length of segments 3 + 4	20	0.93—1.09	1.00	0.04	—	61	0.95—1.15	1.04	0.05	4.68	34	0.94—1.30	1.08	0.08	7.38
length of ant. segment 2: width of pronotal base	25	0.75—0.91	0.80	0.04	4.87	70	0.73—0.85	0.78	0.03	3.88	56	0.86—1.02	0.92	0.12	12.98
length of rostrum	3	1.39—1.41	1.39	—	—	23	1.41—1.65	1.53	0.05	—	15	1.62—1.90	1.75	0.08	—
length of rostrum: length of body	1	0.38	—	—	—	23	0.34—0.45	0.39	0.02	—	15	0.39—0.49	0.44	0.03	—

Table 4. Comparison between the ratio of width of vertex to width of eye according to Woodroffe (1975), Wagner (1975) and the measurements presented in this paper.

Species	sex	Woodroffe 1957	Wagner 1975	measured	
				range	average
<i>perrisi</i>	♂	~ 2.0	1.9—2.0	1.54—2.12	1.76
<i>perrisi/wagneri</i>	♀	~ 2.0	2.0—2.2	1.70—2.38	1.97
<i>wagneri</i>	♂	~ 2.0	1.9—2.0	1.60—2.00	1.76
<i>assimilis</i>	♂	>2.0	—	1.90—2.11	1.98
<i>variabilis</i>	♂	<2.0	1.70—1.75	1.39—2.16	1.78
	♀	—	1.80—1.85	1.80—2.22	2.04
<i>quercus</i>	♂	~ 1.3	1.5	1.30—2.00	1.47
	♀	~ 1.3	1.75	1.72—2.26	2.00

the other hand identification on species level on account of the ratio of width of vertex to width of eye proved to be impossible.

Measurements were made according to the method followed by Wagner (1966: 10, 1970: 20—21) with a Zeiss stereo microscope at magnifications of 20 times (length and width of the body including the wings), 40 times (length of antennae and antennal segments, length of rostrum and width of pronotal base) and 50 times (width of head and width of vertex). The ratio of width of vertex to width of eye was calculated as: width of vertex: 0.5 times (width of head — width of vertex), whereas width of head and width of vertex were measured as shown in fig. 1.

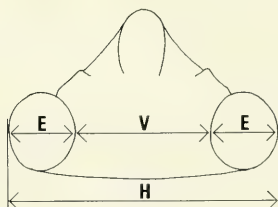
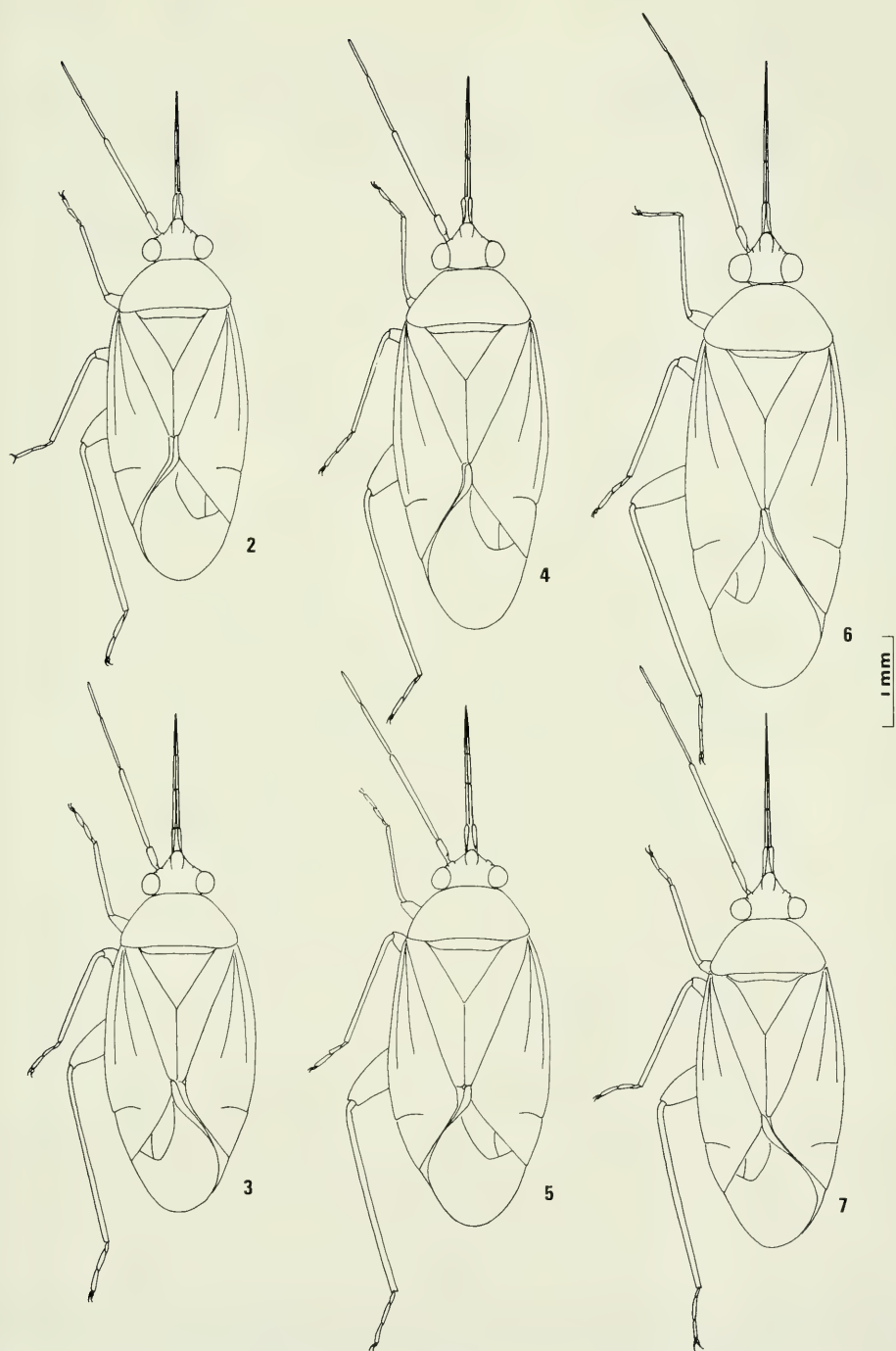


Fig. 1. Measurements of the head: V = width of vertex; E = width of eye; H = width of head.

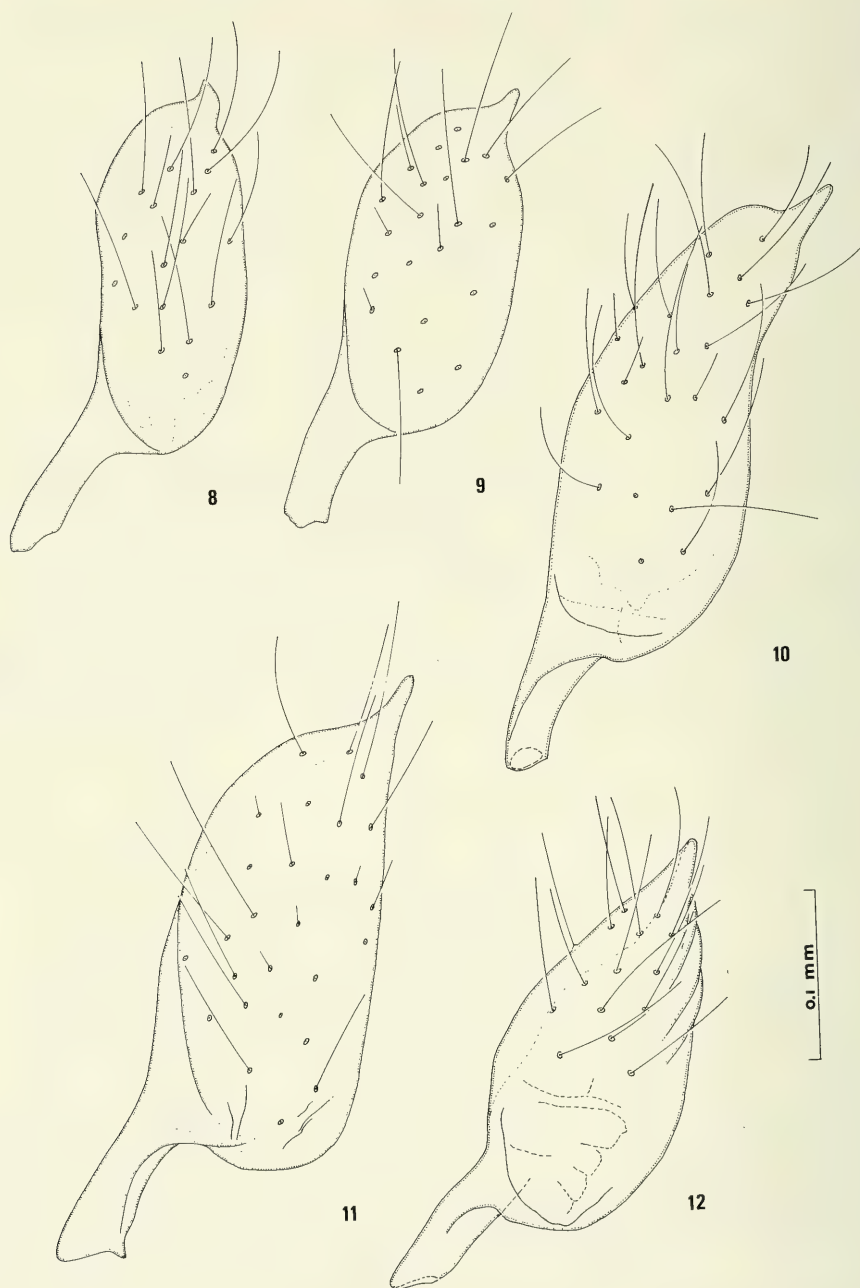
The length of the rostrum in relation to the coxae, used by Stichel (1956) as a distinguishing character, does not provide a reliable character since the extension of the rostrum depends on the slant of the head, on the position of the coxae and on the curvation of the abdomen. Neither does the actual length of the rostrum in relation to the length of the body provide a reliable distinction since a few measurements already show an overlap (tables 1—3).

Small differences between *Hylopsallus* species as regards the shape of the claws have been described (e.g. Wagner, 1952), but these differences are too subtle.

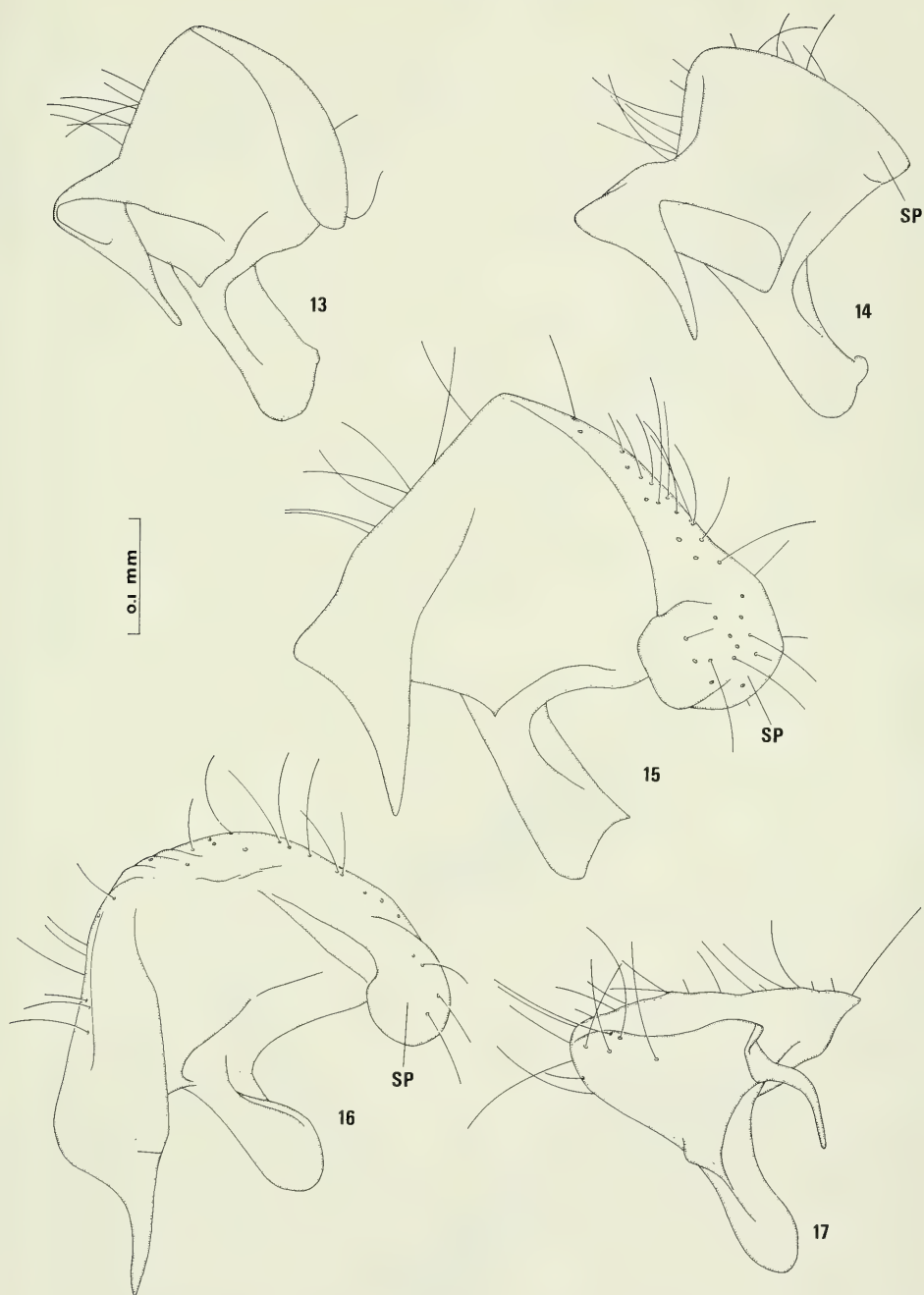
The differences shown by the aedeagi (figs. 23—26) present the only reliable characters for separating all species of *Hylopsallus* concerned. The right parameres (figs. 8—11) are very similar throughout the subgenus, whereas the left parameres (figs. 13—16, 18—21) and the thecas (figs. 28—31) only enable separation of the



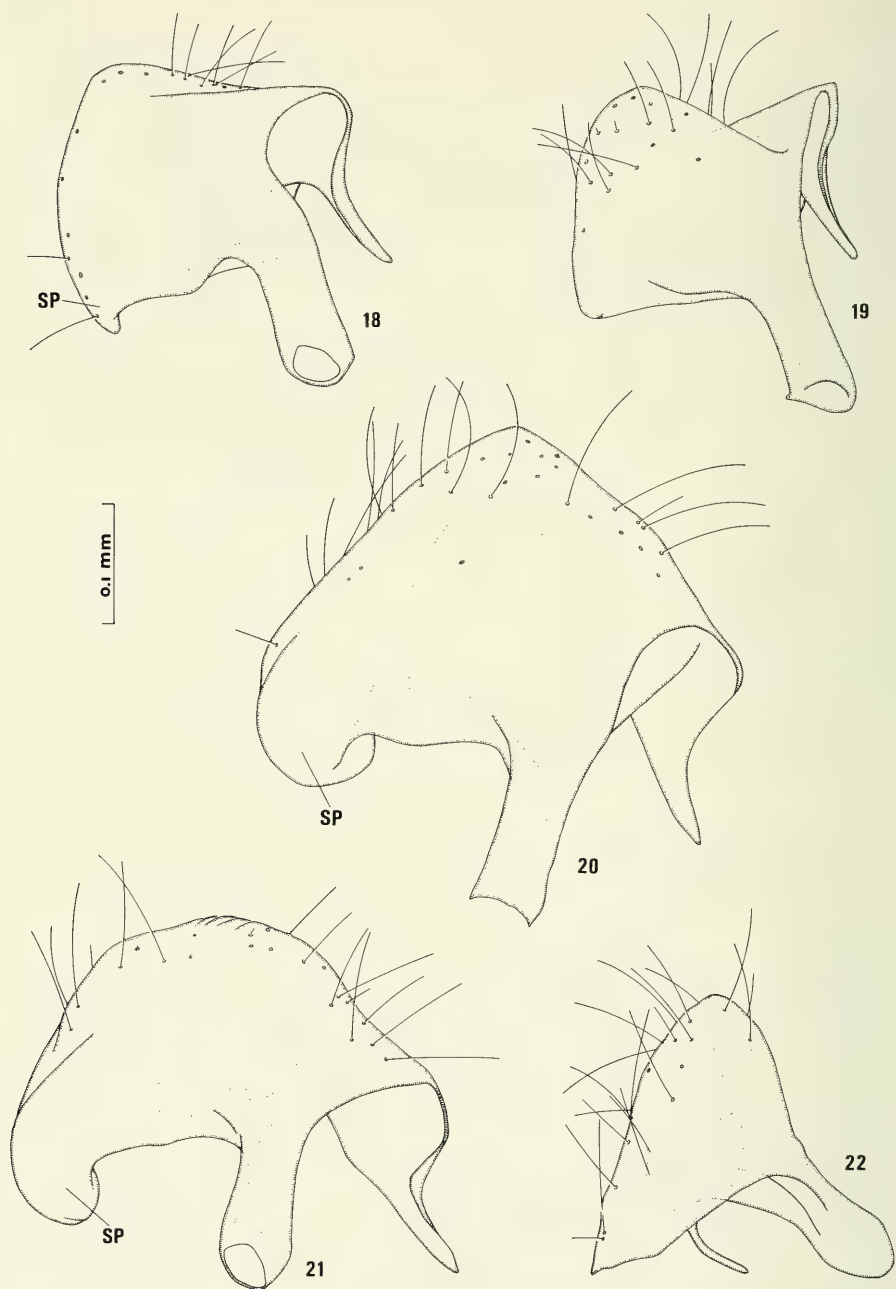
Figs. 2—7. Habitus. 2—3. *Psallus perrisi*, male, female (Amsterdam, the Netherlands); 4—5. *P. variabilis*, male, female (Amsterdam, the Netherlands); 6—7. *Asthenarius quercus*, male, female (Heerde, the Netherlands).



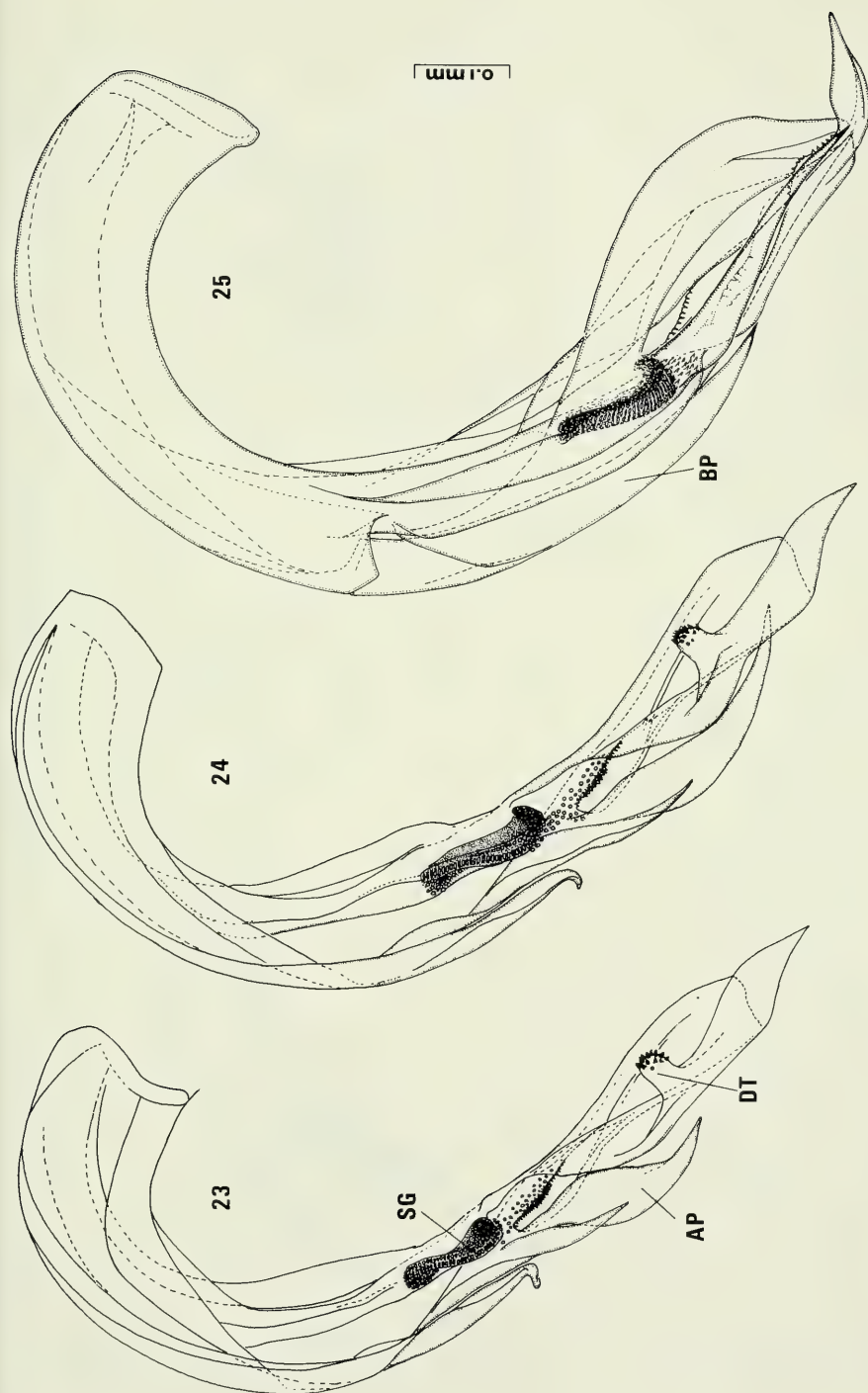
Figs. 8—12. Right parameres. 8. *Psallus perrisi* (Amsterdam, the Netherlands); 9. *P. wagneri* (Heerde, the Netherlands); 10. *P. variabilis* (Amsterdam, the Netherlands); 11. *P. assimilis* (Wychwood, N.B., Oxon, England); 12. *Asthenarius quercus* (Heerde, the Netherlands).



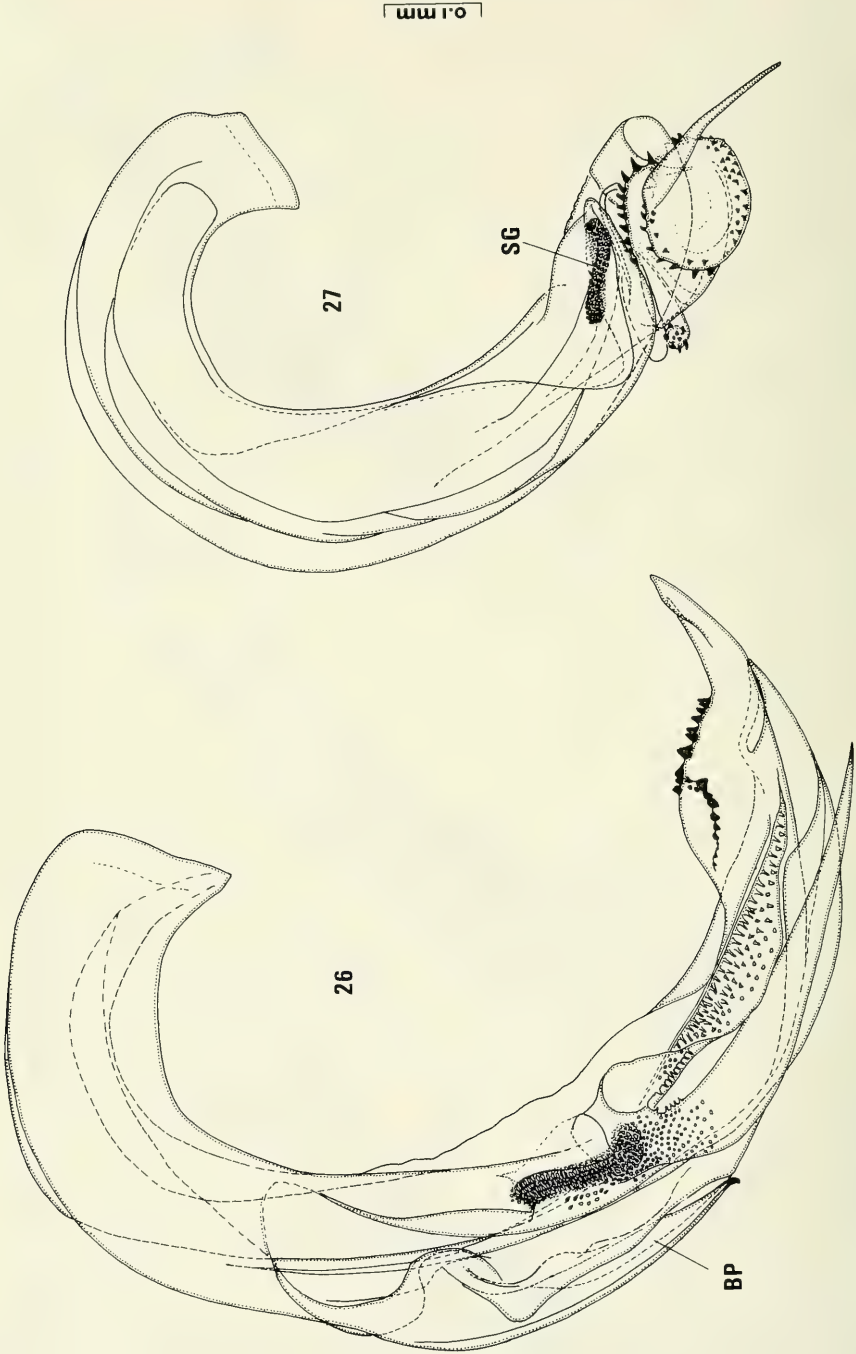
Figs. 13—17. Left parameres, SP = sensorial process. 13. *Psallus perrisi* (Amsterdam, the Netherlands); 14. *P. wagneri* (Heerde, the Netherlands); 15. *P. variabilis* (Amsterdam, the Netherlands); 16. *P. assimilis* (Wychwood, N.B., Oxon, England); 17. *Asthenarius quercus* (Heerde, the Netherlands).



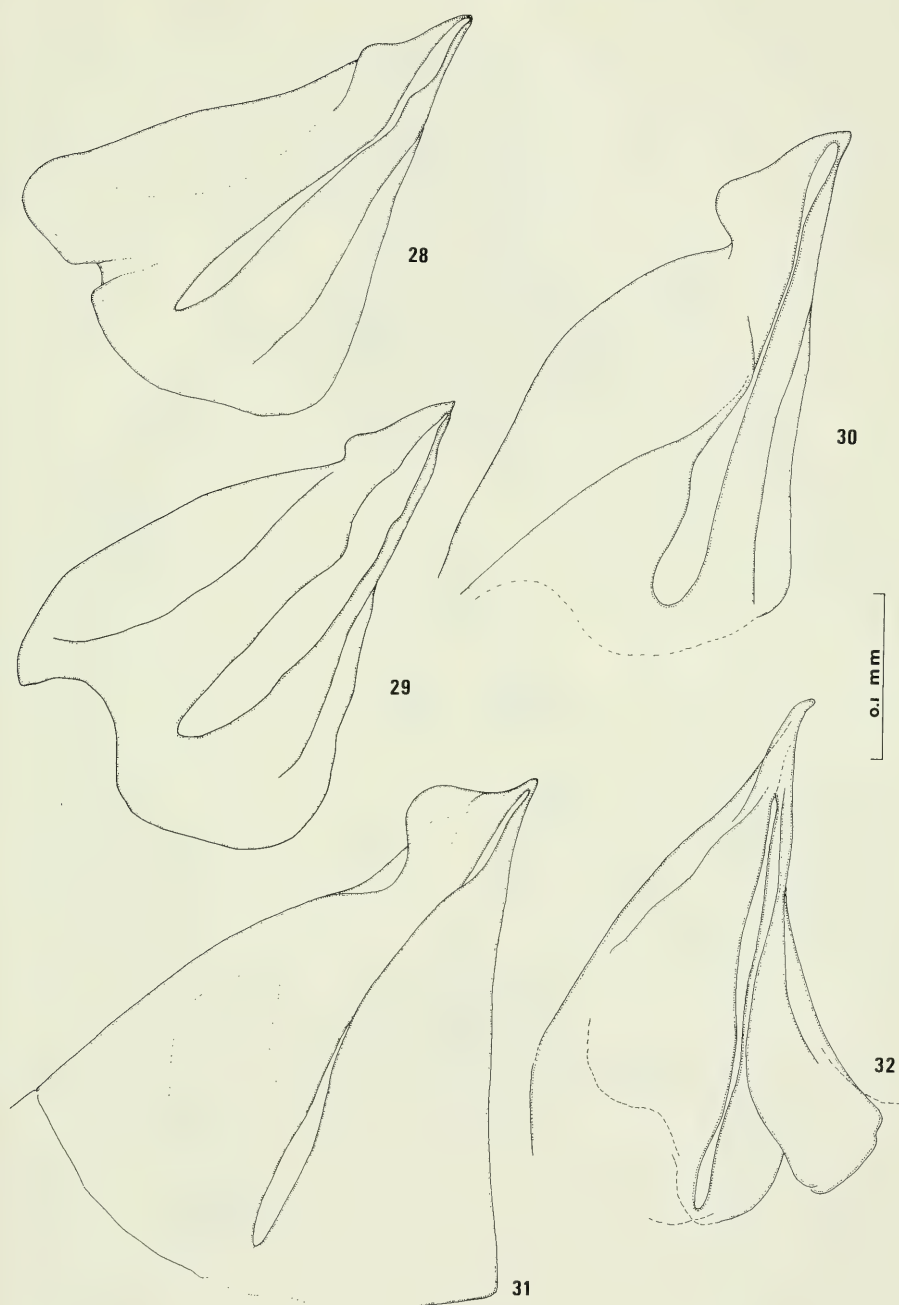
Figs. 18—22. Left parameres from opposite view, SP = sensorial process. 18. *Psallus perrisi* (Amsterdam, the Netherlands); 19. *P. wagneri* (Heerde, the Netherlands); 20. *P. variabilis* (Amsterdam, the Netherlands); 21. *P. assimilis* (Wychwood, N.B., Oxon, England); 22. *Asthenarius quercus* (Heerde, the Netherlands).



Figs. 23—25. Aedeagi, SG = secondary gonophore, BP = basal process, AP = apical process, DT = denticulate tubercle. 23. *Psallus perrisi* (Amsterdam, the Netherlands); 24. *P. wagneri* (Heerde, the Netherlands); 25. *P. assimilis* (Wychwood, N.B., Oxon, England).



Figs. 26—27. Aedeagi, SG = secondary gonophore, BP = basal process. 26. *Psallus variabilis* (Amsterdam, the Netherlands); 27. *Asthenarius quercus* (Heerde, the Netherlands).



Figs. 28—32. Thecas. 28. *Psallus perrisi* (Amsterdam, the Netherlands); 29. *P. Wagneri* (Heerde, the Netherlands); 30. *P. variabilis* (Amsterdam, the Netherlands); 31. *P. assimilis* (Wychwood, N.B., Oxon, England); 32. *Asthenarius quercus* (Heerde, the Netherlands).



Figs. 33—34. Maps of Dutch distributions. 33. *Psallus perrisi*; 34. *P. wagneri*.



Figs. 35—36. Maps of Dutch distributions. 35. *Psallus variabilis*; 36. *Asthenarius quercus*.

males of *perrisi* and *wagneri* from those of *assimilis* and *variabilis*.

Females can only be assigned to either *perrisi/wagneri* or *assimilis/variabilis* by the colour of the hemelytra, the colour of the base of antennal segment 1 and the colour of the femora. Whether the sclerotized rings of the bursa copulatrix might present a good character for separating the species is not known since these structures have not been studied for *Hylopsallus*.

A key to the males of *Hylopsallus* and *Asthenarius quercus* is presented hereafter. A key to the females was not constructed because I am unable to separate the females of *wagneri* from those of *perrisi* and the females of *assimilis* from those of *variabilis*. The differential characters for separating the females of *perrisi* and *wagneri* from those of *assimilis* and *variabilis* can be read from the descriptions of the different species. The presented key resembles mostly the key of Woodroffe (1957) minus the use of ratios.

KEY TO THE MALES

1. Scale pubescence white. Coxae and trochanters greyish white. Aedeagus short and C-shaped, secondary gonophore close to the apex; apex with a long twisted denticulate band ending in a long and narrow apical process (fig. 27) *quercus*
- Scale pubescence golden. Coxae and trochanters red-brown, dark-brown or black. Aedeagus differently shaped, with lateral processes; secondary gonophore distant from the apex (figs. 23—26) 2
2. Body black-brown to black, only immature specimens lighter. Basal one fourth of first antennal segment dark-brown to black. Femora red-brown to dark-brown or black, its extreme apices often yellowish. Sensorial process of left paramere apically acutely angled (figs. 13—14, 18—19). Aedeagus long and slender, provided with three lateral processes and a denticulate tubercle near its apex (figs. 23—24) 3
- Body yellow-brown, red-brown or bright orange-red, sometimes dark-brown. First antennal segment basally only very small dark. Femora dark-brown, their apices broadly red to orange-red. Sensorial process of left paramere apically broadly rounded (figs. 15—16, 20—21). Aedeagus robust, with two lateral processes (figs. 25—26) 4
3. Aedeagus with apical process short and hook-shaped, strongly expanded before apex, its apex just reaching the denticulate tubercle (fig. 23) . . *perrisi*
- Aedeagus with apical process long and narrow, its apex always reaching far beyond the denticulate tubercle (fig. 24) *wagneri*
4. Aedeagus with basal process larger, apically not hooked (fig. 25) . . *assimilis*
- Aedeagus with basal process smaller, hooked apically (fig. 26) *variabilis*

SPECIES ACCOUNTS

In the next section the descriptions of the species are preceded by references to the most important literature and synonyms, and by a list of material examined; they are followed by remarks on biology and distribution.

***Psallus (Hylopsallus) perrisi* (Mulsant, 1852)**
(figs. 2—3, 8, 13, 18, 23, 28, 33)

Mulsant & Rey, 1852: 139—140; Wagner, 1952: 90—94, figs. 1—2; Wagner, 1952a: 176—177, figs. 108, 109a; Stichel, 1956: 287—288, figs. 741—742; Woodroffe, 1957: 258, 260, 262, 267, figs. 1, 23, 43b, 46b; Southwood & Leston, 1959: 221, 224, figs. 76, 85; Wagner, 1967: 145—146, figs. 98F, 99D; Wagner, 1975: 181, 186, figs. 751d, 752b, 753d. — *Apocreminus anticus* Reuter, 1876: 22; Wagner, 1959: 348—349.

Material examined. — The Netherlands: 246 specimens from 58 localities (159 ♂/49 loc., 87 ♀/29 loc.). Great Britain: 17 specimens from 13 localities (8 ♂/6 loc., 9 ♀/8 loc.), coll. British Museum (Natural History), London.

Description

A rather small-sized species, oval in shape (figs. 2—3), body of males and females 2.2—2.6 as long as wide. Black-brown to black, only immature specimens lighter. Pubescence consisting of both shiny golden scales, which are easily rubbed off, and semi-erect black hairs.

Head. — Dark-brown to black, hind margin of vertex often yellowish-brown. Width vertex/width eye ♂: 1.5—2.1, ♀: 1.7—2.4. Antennae light yellow-brown, basal one fourth of segment 1 dark-brown to black; length segment 2/length segment 1 ♂: 3.8—4.7, ♀: 4.0—5.0; length segment 2/length segments 3 + 4 ♂: 0.9—1.3, ♀: 0.9—1.2; length segment 2/width pronotal base ♂: 0.6—0.9, ♀: 0.7—0.9. Rostrum dark-brown to black, segments 2 and 3 often yellow-brown and base of segment 1 ventrally reddish; length ♂: 1.2—1.4 mm, ♀: 1.3—1.5 mm.

Thorax. — Pronotum dark-brown to black. Mesoscutum dark-brown, outer margins often with a reddish tinge. Scutellum dark-brown, sometimes yellow-brown. Hemelytra dark-brown to black. Anterior parts of clavus, corium and embolium more or less brown and tinged with red. Corium near fracture tinged with red and along fracture sometimes whitish. Cuneus red-brown to dark-brown, its central part often darker, basally broadly and apically narrowly whitish. Wing membrane dark-grey with a clear spot just behind outer cell; base and central part sometimes colourless too; veins colourless, sometimes tinged with light-yellow-brown. In females basal part of hemelytra usually totally yellow-brown, sharply contrasting with the darker pronotum and head. Femora red-brown to dark-brown, or black, their extreme apices often yellowish. Hind femora sometimes with a few obscure dark spots beneath. Tibiae yellow, with black spines which arise especially on hind tibiae from dark-brown to black spots. Tarsi yellow, segment 3 dark. Claws yellow-brown, slender; pseudarolia very small.

Ventral surface. — Dark-brown to black, but sometimes more reddish-brown, especially in females. Margins of propleura, sternum and episternum, basalar plate, thoracic spiracle and hind margin of ostiolar peritreme yellowish-white, sometimes tinged with red.

Male genitalia. — Genital segment of male with distinct ventral keel. Right paramere small, oblong (fig. 8). Left paramere small, with sensorial process acutely angled apically (figs. 13, 18). Aedeagus long and slender, its apical process

short, hook-shaped and strongly expanded before the apex, just reaching the denticulate tubercle (fig. 23). Theca small, triangular and more or less equally tapering apically, with a small elevation just before the apex (fig. 28).

Length of body ♂: 3.1—4.0 mm, ♀: 3.0—4.1 mm.

Biology. — In the Netherlands very common on *Quercus*, especially on *Quercus robur* L. Most records from other plants are probably due to stray specimens. Probably phytophagous as well as zoophagous. Imagines are found from mid-May until early August. There is one generation a year and the eggs overwinter in cracks in the bark of year-old oak wood (Southwood & Leston, 1959).

Distribution. — *Psallus perrisi* is a widespread West Palearctic species, thusfar recorded from Finland, Sweden, Norway, Denmark, West Germany, England, the Netherlands (fig. 33), France, Austria, Bulgaria, Greece, South Russia, Asia Minor, Syria and Palestina (Coulianos & Ossiannilsson, 1976; Josifov, 1970; Stichel, 1958; Wagner, 1959, and Wagner & Weber, 1964).

***Psallus (Hylopsallus) wagneri* Ossiannilsson, 1953**
(figs. 9, 14, 19, 24, 29, 34)

Ossiannilsson, 1953: 2—3, figs. 1—5; Stichel, 1956: 288; Woodroffe, 1957: 258, 260, 262, 267, figs. 2, 24; Wagner, 1967: 146, figs. 98E, 99E; Wagner, 1975: 182, 186; Zaytseva, 1969: 526, 529—530, figs. 22—23.

Material examined. — Holotype: Uppland, Djursholm, Ösbysjön, 20.vi.1943, F. Ossiannilsson, ♂, coll. Zoological Institute, University of Lund (Mus. Lund). Paratypes: Uppland, Solna, 23.vii.1942, F. Ossiannilsson, ♂, coll. Mus. Lund; Östergötland, Tjänste, Haglund, ♂, coll. Swedish Museum (Natural History), Stockholm; Bohuslän, 15.vi, A. Tullgren, ♂, and Uppland, Experimentalfältet, 22.vi.1917, A. Tullgren, ♂, both in the coll. of the Swedish Plant Protection Institute, Solna; Bohuslän, Ljung, Lyckorna, B. Tjeder, ♂, and same data but 24.vi.1946, ♂, both in the coll. of B. Tjeder. The Netherlands: 39 males from 19 localities. Great Britain: 9 males from 9 localities, coll. British Museum (Natural History), London. Sweden: 3 males from 2 localities, coll. F. Ossiannilsson.

Description

This species is very similar to *perrisi*. Females are thusfar indistinguishable from those of *perrisi*. Males can only be separated from those of *perrisi* on account of the different shape and size of the apical process of the aedeagus. A description of these distinguishing features of the present species is given below. The measurements of *wagneri* are provided, since the range of variation in *wagneri* appeared to be somewhat different from those of *perrisi*.

Males.

Body 2.3—2.8 as long as wide, 3.1—3.9 mm long.

Head. — Width vertex/width eye: 1.5—2.0. Antennae: length segment 2/length

segment 1: 3.8—4.8; length segment 2/length segments 3 + 4: 0.9—1.1; length segment 2/width pronotal base: 0.7—0.9.

Male genitalia. — Right paramere (fig. 9) small and oblong, as in *perrisi*. Left paramere (figs. 14, 19) with sensorial process acutely angled apically as in *perrisi*. Aedeagus (fig. 24) as in *perrisi* (fig. 23), but with apical process long and narrow, its apex always reaching well beyond the denticulate tubercle. Theca (fig. 29) as in *perrisi*.

Biology. — In the Netherlands fairly common on *Quercus*, especially *Quercus robur* L. Often together with *perrisi* imagines are found from mid-May until the end of July. There is one generation a year and the eggs overwinter.

Distribution. — *Psallus wagneri* is a West Palearctic species, thusfar recorded from Finland, Sweden, Denmark, West Germany, the Netherlands (fig. 34), the Baltic States, Bulgaria and Central and South Russia (Coulianos & Ossiannilsson, 1976; Josifov, 1970; Stichel, 1958; Wagner, 1959; Wagner & Weber, 1964 and Zaytseva, 1969). Probably a widespread species, which is however often confused with *perrisi* and *variabilis*.

***Psallus (Hylopsallus) variabilis* (Fallén, 1829)**
(figs. 4—5, 10, 15, 20, 26, 30, 35)

Fallén, 1829: 98; Wagner, 1952: 90—94, figs. 1—2; Wagner, 1952a: 177—178, figs. 108, 109b; Stichel, 1956: 289; Stichel, 1958: 794, figs. 744, 973; Woodroffe, 1957: 258, 260, 262, 267, figs. 6, 26; Carvalho, 1958: 33; Southwood & Leston, 1959: 221, 225, figs. 77, 82; Wagner, 1967: 145, figs. 97G, 98C, 99C; Wagner, 1975: 181, 185, figs. 751c, 752a, 753c.

Material examined. — The Netherlands: 229 specimens from 57 localities (81 ♂/34 loc., 148 ♀/50 loc.). Great Britain: 7 specimens from 5 localities (3 ♂/2 loc., 4 ♀/3 loc.), coll. British Museum (Natural History), London.

Description

A small species, oval in shape (figs. 4—5), body of males 2.3—2.8 and females 2.1—2.6 as long as wide. Yellow-brown, red-brown, bright-orange-red, sometimes dark-brown. Pubescence as in *perrisi*.

Head. — Dirty yellow-brown to dark-brown, sometimes with a reddish tinge. Width vertex/width eye ♂: 1.4—2.2, ♀: 1.8—2.2. Antennae yellow-brown, segment 1 basally only very small dark; length segment 2/length segment 1 ♂: 3.6—4.8, ♀: 3.8—4.6; length segment 2/length segments 3 + 4 ♂, ♀: 0.9—1.1; length segment 2/width pronotal base ♂, ♀: 0.7—0.9. Rostrum yellow-brown, segments 1 and 4 more or less dark-brown, and base of segment 1 ventrally whitish with a red tinge; length ♂: 1.4—1.5 mm, ♀: 1.4—1.6 mm.

Thorax. — Pronotum light-yellow-brown to dark-brown, tinged with black and sometimes anteriorly and/or posteriorly with dark markings. Pronotum especially in females sometimes tinged with red or orange-red. Mesoscutum and scutellum coloured as pronotum; lateral margins of both mesoscutum and scutellum and

apex of scutellum usually somewhat lighter. Hemelytra light-yellow-brown to dark-brown, especially near apex more or less tinged with red or orange-red. Central parts sometimes dark-brown to blackish, especially in males. Cuneus yellow-brown, red-brown to deep-red, basally more or less white along fracture. Wing membrane dark-grey to black, with a clear spot just behind the outer cell. Veins colourless to greyish, usually tinged with red. Femora dark-brown, apically broadly red to orange-red, sometimes with a few indistinct dark spots beneath. Tibiae light-yellow with black spines arising from distinct dark spots, especially on hind tibiae. Tarsi yellow, segment 3 dark apically. Claws yellow-brown, slender; pseudarolia very small.

Ventral surface. — Light-red-brown to dark-brown, with the same yellowish-white parts as in *perrisi*, sometimes with a red tinge.

Male genitalia. — Genital segment of male with a distinct ventral keel. Right paramere large and oblong (fig. 10). Left paramere large, with sensorial process broadly rounded apically (figs. 15, 20). Aedeagus oblong and robust, with two lateral processes; basal process short and apically hooked (fig. 26). Theca somewhat larger than in *perrisi* and *wagneri*, with a more distinct elevation just before the apex (fig. 30).

Length of body ♂: 3.5—4.4 mm, ♀: 3.3—4.3 mm.

Biology. — In the Netherlands common on oak, especially on *Quercus robur* L. Imagines are found from mid-May until early August. There is one generation a year and the eggs overwinter.

Distribution. — A widespread West Palearctic species, known from Finland, Sweden, Norway, the Baltic States, West Russia, Poland, Germany, Denmark, Scotland, Ireland, England, the Netherlands (fig. 35), Belgium, France, Spain, Algeria, Italy, Switzerland, Austria, Czechoslovakia, Hungary, Yugoslavia, Albania, Greece, Bulgaria, Roumania, South Russia and Turkestan (Stichel, 1958; Zaytseva, 1969).

***Psallus (Hylopsallus) assimilis* Stichel, 1956**
(figs. 11, 16, 21, 25, 31)

Stichel, 1956: 289; Woodroffe, 1957: 258, 260, 262, 267, figs. 3, 27; Stichel, 1958: 795, fig. 973; Southwood & Leston, 1959: 221, 224, fig. 87; Wagner, 1967: 145, figs. 98b, 99F.

Remarks. — Woodroffe (1957) pointed out that *Apocremnus simillimus* Douglas & Scott, 1865 (nec Kirschbaum, 1856) represents a good species. Since the publication of Reuter (1878) *simillimus* Douglas & Scott, 1865, was considered a variety of *Psallus (Hylopsallus) variabilis* (Fallén, 1829), which was renamed f. *assimilis* by Stichel in 1956 since Douglas & Scott's name was a homonym of the earlier Kirschbaum species. Following Stichel (1956) Woodroffe (1957) used the name *Psallus (Hylopsallus) assimilis* Stichel, 1956, for the species originally described by Douglas & Scott. When I tried to establish the identity of the specimens after which Douglas & Scott described their *Apocremnus simillimus* it

appeared that the three specimens in the Hope Department of Entomology, Oxford University Museum collected by Douglas from Maple at Box Hill, Surrey, are females. Consequently the identity of *simillimus* remains uncertain. The fact however that the specimens of Douglas were collected in England and on Maple strongly supports Woodroffe's interpretation of *simillimus*. Whether or not Stichel's interpretation of *simillimus* was correct, I regard the name *assimilis* Stichel, 1956 as a valid replacement name for *simillimus*.

Material examined. Great Britain: 48 specimens from 19 localities (15 ♂/9 loc., 33 ♀/17 loc.). Coll. Hope Department of Entomology, Oxford University Museum: Box Hill, Surrey, J. W. Douglas, Maple, 3 ♀; 1870, J. W. Douglas, 3 ♀; Reigate, vi, 1882, 1 ♂, 2 ♀; Renhold, Beds., 6.vii.1962, D. Leston, Maple, 3 ♂, 3 ♀; the same, 30.vi.1963, 1 ♂ (slide Xk4). Coll. British Museum (Natural History), London: Chingford, 10.vi.1911, E. A. Butler, 1 ♀; East Malling, Kent, 27.vi.1945, A. M. Massee, 1 ♀; Stondon Massey, Essex, 12.vi.1953, A. M. Massee, 1 ♀; Epping Forest, Essex, 15.vi.1953, A. M. Massee, 1 ♀; Ditton, 24.vi.1954, Poplar, 1 ♀; the same, 1.vii.1954, 1 ♀; Eaglefieldern, 10.vii.1954, G. E. Woodroffe, Maple, 1 ♂, 1 ♀; Hedgerley, vi.1955, Maple, 1 ♀; Runnymede, 10.vi.1955, G. E. Woodroffe, 3 ♂, 3 ♀; Windsor Forest, Berks., 16.vi.1955, G. E. Woodroffe, Maple, 1 ♂, 3 ♀; Ham Street, Kent, 12.vi.1960, A. M. Massee, 2 ♀; Old Burghclere, Beacon Hill, Hants., 23.vii.1962, G. E. Woodroffe, Maple, 1 ♂, 3 ♀; Aston Ravent, N. R., 1.vii.1965, G. E. Woodroffe, 1 ♂; 88—11, 7.vi.1966, Scott, 1 ♂; Wychwood, N. B., Oxon, 6.vii.1966, G. E. Woodroffe, 1 ♂; the same, 8.vii.1969, Maple, 1 ♂, 2 ♀; Power, Birch Wood, 69—31, Birch, 1 ♂.

Description

This species is very similar to *variabilis*. Males only can be separated on account of differences in the aedeagi, but I am not able to separate the females from those of *variabilis*. Woodroffe (1957) also separated the males of *assimilis* from those of *variabilis* by the thickening of antennal segment 2: distinctly thickened in *variabilis* and only slightly so in *assimilis*. Basing myself upon the material available for this study I believe that such a difference does not exist. In Britain however, where *variabilis* is seemingly rare, the host plant may be a valuable guide for identification.

In the following lines I give a differential diagnosis for *assimilis*, including the ranges of variation of the measurements, which are somewhat different from those of *variabilis*.

Length body/width body ♂: 2.2—2.5, ♀: 2.1—2.4; length of body ♂: 3.4—3.8 mm, ♀: 3.5—4.0 mm.

Head. — Width vertex/width eye ♂: 1.9—2.1, ♀: 1.9—2.4; length antennal segment 2/length segment 1 ♂: 4.0—4.7, ♀: 3.8—4.7; length segment 2/length segments 3 + 4 ♂, ♀: 0.9—1.1; length segment 2/width pronotal base ♂: 0.8, ♀: 0.7—0.9.

Male genitalia. — Right paramere (fig. 11) and left paramere (figs. 16, 21) as in

variabilis. Aedeagus (fig. 25) with basal process longer than in *variabilis*, not hooked apically. Theca (fig. 31) as in *variabilis*.

Biology. — Host plant: *Acer campestre* L. In England imagines are found from early June until the end of July. There is one generation a year and eggs overwinter.

Distribution. — *Psallus assimilis* is thusfar recorded only from England and West Germany (Stichel, 1958; Rieger, 1975; 1976). The occurrence of *assimilis* in Finland as mentioned by Stichel (1958) has not been confirmed (Coulianos & Ossiannilsson, 1976).

***Asthenarius quercus* (Kirschbaum, 1856)**
(figs. 6, 7, 12, 17, 22, 27, 32, 36)

Kirschbaum, 1856: 253; Wagner, 1952: 176, fig. 108; Stichel, 1956: 290, fig. 745; Woodroffe, 1957: 258, 260, 262, 265, figs. 4, 25; Carvalho, 1958: 128—129; Southwood & Leston, 1959: 220, 225, figs. 75, 83; Kerzhner, 1962: 232; Wagner, 1967: 145, figs. 98D, 99B; Zaytseva, 1969: 526, 528—529, figs. 10—14; Wagner, 1975: 183—184, figs. 751b, 753b; Wagner, 1975a: 242—243, fig. 6. — *Capsus similimus* Kirschbaum, 1856: 233; Wagner, 1943: 34—36.

Material examined. — The Netherlands: 170 specimens from 46 localities (74 ♂/30 loc., 96 ♀/38 loc.).

Description

A relatively large species; males elongate, rather parallel-sided (fig. 6), females smaller, elongate-oval (fig. 7). Length body/width body ♂: 2.3—2.9, ♀: 2.1—2.7. Dark-brown to red-brown, females often lighter than males. Pubescence consisting of both shiny white scales, which are easily rubbed off, and semi-erect black hairs.

Head. — Dark-brown to red-brown, sometimes blackish. Width vertex/width eye ♂: 1.3—2.0, ♀: 1.7—2.3. Antennae yellow-brown, especially in segments 1 and 2 tinged with red. Segment 1 basally very small dark. Length segment 2/length segment 1 ♂: 4.2—5.4, ♀: 4.2—5.3; length segment 2/length segments 3 + 4 ♂: 1.0—1.3, ♀: 0.9—1.3; length segment 2/width pronotal base ♂: 0.9—1.1, ♀: 0.9—1.0. Rostrum dark-brown to red-brown, base of segment 1 ventrally white with reddish tinge; length ♂: 1.6 mm (only 2 specimens measured), ♀: 1.6—1.9 mm.

Thorax. — Pronotum dark-brown to red-brown, sometimes blackish, but posterior angles or entire hind margin often lighter. Mesoscutum and scutellum coloured as pronotum, laterally often lighter. Hemelytra dirty grey-brown to dark-brown, basally often lighter, sometimes greyish-yellow. Apex and lateral margin more or less tinged with red. Cuneus red-brown, with base along fracture narrowly whitish. Wing membrane greyish to black-grey with a clear spot just behind outer cell. Veins colourless, sometimes tinged with red-brown or red. Femora basally

dark-brown to red-brown, apically coloured lighter, bright-red or yellow-brown with a red tinge. Hind femora sometimes with a few obscure dark spots beneath. Coxae and trochanters greyish-white in males and white in females. Tibiae yellow with red tinge, especially in hind tibiae; apices small blackish. Tibiae with strong black spines arising from large black to dark-brown spots, which are however smaller in mid and fore tibiae. Tarsi yellow-brown, segment 3 mainly dark. Claws yellow-brown; pseudarolia small.

Ventral surface. — Red-brown to dark-brown; thoracic spiracle, epimeron, ostiolar peritreme, basalar plate and margins of propleura whitish with a red tinge.

Male genitalia. — Genital segment with a distinct ventral keel. Right paramere small and oblong (fig. 12); left paramere small, with sensorial process acutely angled apically (figs. 17, 22). Aedeagus short and C-shaped, without lateral processes, its apex with a long twisted denticulate band ending in a long and narrow apical process (fig. 27). Secondary gonophore situated near apex. Theca small and strongly tapering apically without elevation before apex (fig. 32).

Length of body ♂: 3.8—4.7 mm, ♀: 3.5—4.3 mm.

Biology. — In the Netherlands common on its host plant oak, especially on *Quercus robur* L. Imagines are found from mid-May until the end of July. There is one generation a year and eggs overwinter.

Distribution. — A very widespread West Palearctic species, known from Finland, Norway, Poland, Germany, Denmark, Scotland, England, the Netherlands (fig. 36), Belgium, France, Spain, Portugal, Italy, Switzerland, Austria, Czechoslovakia, Hungary, Yugoslavia, Bulgaria, Roumania and South Russia (Stichel, 1958).

CONCLUDING REMARKS

Very little is known of the biology of the Dutch species of *Hylopsallus*, whereas knowledge of that kind is essential for understanding processes of speciation within such a group of closely related species. Especially in the case of *perrisi* and *wagneri*, which differ only in size and shape of the aedeagus, and occur on the same host plant in the same period of the year, it is difficult to understand their relationships. The same applies for *Psallus* (*Hylopsallus*) *kiritshenkoi*, which is described by Zaytseva (1969) from South Russia. This species differs from *perrisi* and *wagneri* only in size and shape of the apical process of the aedeagus, which is intermediate between those of *perrisi* and *wagneri*!

It is clear that further study of the biology of these species and rearing and cross-breeding experiments are necessary to unravel the relationships of these morphologically ill-defined species.

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INHOUD

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THE MICRO-LEPIDOPTERAN GENUS *ECTOEDEmia* BUSCK (NEPTICULIDAE) IN NORTH AMERICA

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With 71 text-figures

ABSTRACT

This paper, together with the monograph by Wilkinson & Scoble (1979) forms a comprehensive taxonomic account of the genus *Ectoedemia* Busck in North America. Species are here fully diagnosed and illustrated with drawings of the external features and genitalia. Notes on their biology are also included.

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An index to the names of taxa dealt with in the present paper can be found at the end of the following paper.

INTRODUCTION

In this revision twenty-two species are considered. Five are new combinations, two are new species and nine are diagnosed and figured which have previously

been described by Wilkinson & Scoble (1979). Those species attacking bark are described at the end and form a clear group separable on the basis of genitalia from the leaf and petiole miners. In the same way other groups amongst the latter are recognisable. However, those attacking petioles, e.g. *E. populella* and *canutus*, are included in one of the groups of leaf-miners. This action is supported by the presence of an intermediate habit. In *argyropeza* the larva first bores into the petiole and later continues to mine the leaf.

Thus in *Ectoedemia* it is now definitely established that three sites of attack exist: leaf, petiole and bark. There is also a reference to attack in the cortex. Both galls and mines are found in these locations.

There has been much discussion in the past regarding the boundaries of the genus. This revision, with the advantage of additional material, sheds light on this debate.

METHODS

The methods used are similar to those given in Wilkinson & Scoble (1979) as are also the terms used, although in the five years that have elapsed since the former work was completed we have modified some of our terminology. We have come to realise that a thorough comparative morphological study of the various nepticulid genera is long overdue, not only to ascertain homologies within the group but also with other families. At present one is not always certain that parts of genitalia given the same names as those in the Ditrysia are indeed homologous. For example the interpretation of the term "saccus" by Beirne (1945) is unclear and has not been adopted by other workers to mean a part of the integument as he seems to interpret it. Here "saccus" refers to the anterior extension of the vinculum in front of the ventral plate and is the area often extended into a bilobed protrusion. Whether this is homologous with the saccus of Ditrysia is uncertain and therefore the continued use of the term is open to question.

"Pseuduncus" is a posterior extension of the tegumen and a true uncus is not present in *Ectoedemia*. However, some species have a thickened area in the region where an uncus might be expected to arise. Scoble (verbal communication) suggests that at least in the African species he has examined, the thickening represents a forward fold of the pseuduncus and therefore the uncus is still absent. Expendable material of *trinotata* would be particularly useful for the investigation of this point.

"Anellar lobes" refers to the large spines located at the end of the aedeagus. It is not always certain if they are homologous. It is assumed they provide the normal supporting role for the aedeagus. Sometimes, however, they might be more referable to the juxta or aedeagus proper.

Scale. — On the genitalia figures the scale line represents one tenth millimeter (1/10 mm) unless otherwise indicated. The magnification of the external figures can be ascertained from the *al.ex.* measurements (taken from centre of mesothorax to wing tip and doubled) given for each species.

ABBREVIATIONS

Institutes from which material was borrowed:

- USNM — United States National Museum of Natural History, Smithsonian Institution, U.S.A.
- CNC — Canadian National Collection, Biosystematics Research Institute, Ottawa, Canada
- FIS — Forest Insect Survey, British Columbia, Canada
- SOO — Forestry Service, Environment Canada, Sault Ste. Marie, Canada
- ANS — Academy of Natural Sciences, Philadelphia, U.S.A.
- BM (NH) — British Museum (Natural History), London, U.K.
- MCZ — Museum of Comparative Zoology, Cambridge, Massachusetts, U.S.A.
- DFF — Department of Fisheries and Forestry, Forestry Service, (now Environment Canada), Ste. Foy, Quebec, Canada.

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TAXONOMIC HISTORY

The question of the significance of larval feeding habit and the pattern of forewing venation has led to some confusion in the past and is now the focus of discussions on the composition of this genus and its phylogeny with respect to the other members of the family. The genus was originally described by Busck (1907) as monotypic, because the species *populella* which, despite affinities with *Stigmella* Schrank could not be included within its confines. The genus and author were cited incorrectly by Busck as *Nepticula* Zeller. His action was right but his reason was wrong. It was that the gall-forming habit of *populella* excluded it from the leaf-mining species of *Stigmella*. Busck also gives major morphological differences between the types of *Stigmella* and *Ectoedemia*, including the closed cell of the forewing venation formed by the medial cross-vein, which is actually also present in other genera. For some time Braun had been aware of the two basic forms of forewing venation, those with a medial cross-vein and those without. This feature, however, was not given taxonomic status by her for a number of reasons. Firstly, she regarded otherwise closely related species and sometimes male and female individuals of the same species as showing both conditions of the pattern of venation (Braun, 1917: 157, and figs. 1 and 2). This conclusion was the result of misidentification of a single species (*nyssaefoliella*), which she thought had both forms of venation and, more generally, is due to the absence of any study of the genital morphology at that time. Again Braun and other of her contemporary workers regarded the mining habit of the larvae as the most significant indication of phylogeny. It was not until later examination of the genital morphology that evidence in favour of uniting leaf-mining species and gall-forming species within a single genus, became available.

Beirne (1945) divided the family into two basic groups on the form of the male genitalia, those with a ring-shaped vinculum and those with an incomplete vinculum. This led him to erect the genus *Dechtiria* for those leaf-mining species with distinct differences in genitalia from the leaf-mining *Stigmella* (and *Nepticula* sensu Beirne) species. A study of the group by Svensson (1966: 200) with a comparison of genital morphology and venation of North American types, led him to synonymise the European genus *Dechtiria* with the North American *Ectoedemia* Busck. This decision has been accepted by Wilkinson & Scoble (1979), who included seven leaf-mining species, which were earlier assigned to *Stigmella*, in *Ectoedemia*. In the present study a further five species are combined with *Ectoedemia*, all of which are leaf-miners. Beirne (1945: 204) noted that in the genus *Dechtiria*, with the exception of two species only, all species formed leaf-mines which terminated in blotches. In the present revision only one included species, *virgulae*, forms a linear leaf-mine. The remainder form either true blotches or linear mines terminating in blotches.

Immediately after the publication by Zimmermann (1940) of work on the bark-miner, *Ectoedemia liebwerdella* Zimmermann, Hering (1940) erected the genus *Zimmermannia*, with this species as the type. Hering proposed this division on the basis of a difference in larval feeding habit, comparing the North American type *populella* Busck, which forms petiole galls in poplar, and the European species *liebwerdella*, which burrows in the bark of beechwood. Hering noted that the two species were indistinguishable in the pattern of wing venation but that they differed in that *liebwerdella* possesses a row of sharp bristles on the inner side of the hind-tibiae. Borkowski's study (1972: 693) points out that this character is present in all the European *Ectoedemia* species he examined, whether gall forming or bark burrowing. This view is also held here for the American species but there is some variation in the prominence of the bristles.

Schönherr (1957: 127; 1958: 6) subsequently synonymises *Zimmermannia* with *Ectoedemia* and gives it subgeneric rank. This is confirmed by Borkowski (1972), who points out that the morphological differences given by Hering are not sufficient to warrant generic status being attached to *Zimmermannia*. He also presents a summary of the treatment of the three genera at the time and supports the division of *Ectoedemia* sensu lato into three subgenera corresponding to larval feeding habit: the petiole-miners, *Ectoedemia* Busck; the leaf-miners, *Dechtiria* Beirne; and the bark-miners, *Zimmermannia* Hering. The group is treated similarly by Emmet (1976) in his revision of the British fauna.

Although Borkowski is in some doubt that sufficient work was done by Svensson in his synonymy of *Dechtiria* with *Ectoedemia*, it is felt that the work by Wilkinson & Scoble (1979) on the Canadian fauna and the present study confirms the synonymy. On the basis of genitalia and wing venation the authors also support the synonymy of *Zimmermannia* with *Ectoedemia*. However, from this study it is possible to identify morphological divisions, mainly based on genitalia structures, within the genus, which correspond with the sites of larval attack.

Johansson (1971: 241) is of the opinion that the family Nepticulidae may be split into two genera, *Nepticula* and *Trifurcula*. He argues that *Trifurcula* has been subdivided into several genera including *Ectoedemia* and *Dechtiria*, but that these should

be included as subgenera of *Trifurcula* on the basis of male genitalia. This scheme is followed more recently by Karsholt & Schmidt Nielsen (1976) in the catalogue of Danish Lepidoptera. Although there is merit in the proposal, this classification is not adopted in this revision for reasons given by Wilkinson & Scoble (1979). It was pointed out earlier that there are no significant structural differences between the bark-miners and bark gall-formers. For example, *heinrichi* and *castaneae* cannot be reliably separated without knowledge of the host plant and damage. However, examination of the genitalia figures shows that species which attack bark (whether galls or mines) have characteristic genitalia and leads one to guess at the habits of those whose life history is unknown. The three species recorded here as attacking petioles can be placed in the same morphological group on the basis of genital structures, but the group also contains leaf-miners.

TAXONOMIC CONSIDERATIONS

The similarity in morphological structures, even genitalia, between *castaneae* and *heinrichi*, highlights problems over the species concept in this group of Lepidoptera. Knowledge of the life history leads us to separate two species which otherwise might have been regarded as one. Speciation is much more extensive than has hitherto been recognised and many species are only known through the excellent rearing work of Braun and others. In this genus alone, many species are shown to have more than one form in the externals, particularly wing markings, which is not matched by differences in the genitalia. At first sight a species appears to be di- or polymorphic, but without knowledge of the life cycles, we cannot be sure that these variants are not distinct species. For example, three wing pattern forms occur in what has been called *E. similella*. Although they have identical genitalia, one form occurs in Ohio, New Jersey and Virginia, another form in Florida. A single specimen with different markings has been collected from Arkansas. Host plants are only known for the Ohio form (*Quercus palustris* and *Q. rubra*).

A specimen (nr. 7) probably represents a new species close to *rubifoliella*. It differs in ground colour and certain aspects of the genitalia. It was reared by Braun from a collection of similar mines on *Quercus platanoides* but the rest turned out to be *Stigmella flavipedella* (Braun) comb. n. This is one of a number of examples which shows that each larva should be reared separately, as far as practicable, and also have a separate rearing number. The fact that the host plants of *rubifoliella* and specimen 7 are so different, supports the view that specimen 7 should be treated as a new species but this has not been done in case there is anything spurious about its breeding record. Otherwise its similarity to *rubifoliella* is quite striking. The male genitalia figures are drawn to accentuate the differences which may not be so easy to diagnose as they at first seem.

Of course, the problem must also be approached from the other direction. It is quite possible that a species could attack more than one part of a plant. It is known that *E. argyropeza downesi* mines both the petiole and the lamina. It is also possible that the same species may create mines or galls depending upon the site of oviposition. Although many species are monophagous not all are, and we should therefore be prepared for dimorphism or different reactions from different host

plants to the same species. Some authorities think this unlikely but there is considerable danger in the philosophy — two species of host plant, therefore *ipso facto* two species of miner! However, hopefully these problems will encourage experimental work designed to discover the flexibility in miner and host plant relationships within the Nepticulidae. Meanwhile these cases underline the point that no one character, or series of characters, can be taken as necessarily species-diagnostic throughout the Nepticulidae or even for *Ectoedemia*.

There has been debate regarding the division of the genus into sub-genera and also whether *Ectoedemia* comprises, in reality, more than one genus. Much more information on life cycles is needed to answer this, but this paper shows that the criteria previously used for separations are inadequate. The genitalia structures allow us to divide *Ectoedemia* into broad groups and it seems that those species attacking bark (both mining and gall-forming) are particularly diagnostic. However, we do not yet know whether all those species assigned to the group do, in fact, attack bark. In other groups it can be argued that one or two species (*trinitata*, *nyssaefoliella*) have males belonging to a different group from the females, thus suggesting that the groups are not fundamental. Our present level of knowledge recommends us to regard these species as representing one genus and our studies of *Ectoedemia* on other continents will shed further light on these conclusions. It is interesting to note how some genera of Nepticulidae are worldwide in their distribution whilst others are comparatively localised.

GENERIC DESCRIPTION

External features: ♂ ♀. Head: palps extending well beyond labrum, pale grey or white; antennae approximately half length of forewings, pale or fuscous; tuft on front of head usually ochreous, sometimes white or brown, vertex concolourous; eye-caps always whitish; collar white or ochreous, sometimes fuscous. Thorax dark brown to black, sometimes white or buff and irrorate, usually iridescent. Abdomen grey or brown, iridescent metallic grey beneath. Venation as in figs. 1 or 2. Forewings: Media coalescing with cubitus at base and passing obliquely to radius at or beyond R_{2+3} and anastomosing beyond middle of wing; cubitus usually reaching margin; R_4 and R_5 separate; anal vein sometimes meeting cubitus distally. Hindwings: Media single-branched. Forewings: elongate and ovate in shape, ground colour of dorsal surface generally fuscous with each scale darker at the tip, rarely pale and irrorate with fuscous; fringe pale grey or brown and iridescent, usually marked apically with a band of wing-scales or variously irrorate; markings usually in the form of up to four streaks or patches, never with more than one complete fascia. Hindwings: narrow and lanceolate, sometimes with costa emarginated; pale grey or brown and sometimes with white or ochreous patches of specialised scales. Legs: grey or brown, sometimes with scattered paler areas; proximal pair of spurs on hind-tibiae at or below the middle (fig. 3); hind-tibiae with many sharp bristles inwardly directed and variable in prominence.

Male genitalia: Vinculum always ring-shaped; tegumen fused with vinculum dorsally and produced into broad tapering, pointed or bluntly rounded pseuduncus. Uncus often not readily visible, only present as membranous lobe at base of pseu-

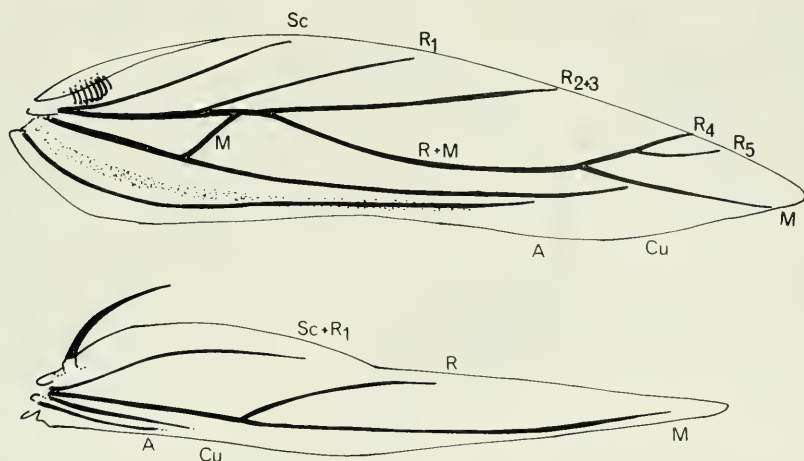
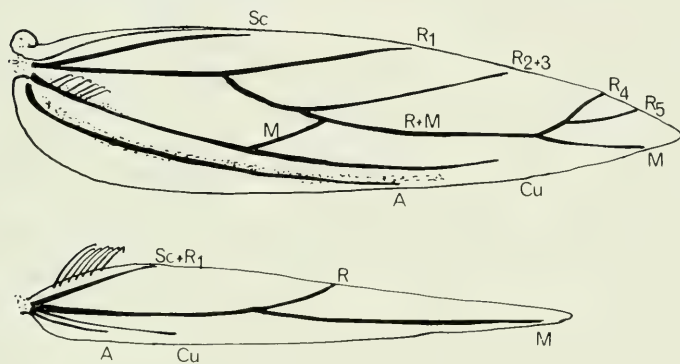
1 *Ectoedemia obrutella* ♂2 *Ectoedemia similella* ♀

Fig. 1. *Ectoedemia obrutella* (Zeller) Busck, ♂, wing venation. Fig. 2. *E. similella* (Braun), ♀, wing venation.

duncus. Gnathos with medial arms fused to form central boss or tapering process, lateral arms rarely extended or bifurcate. Saccus bilobed to various degrees. Valves usually tapering and inwardly curved distally, sometimes weakly bifurcate and in some cases adorned with digitate setae. Transtillae usually U-shaped; transverse bars continuous, fused medially. Juxta absent. Aedeagus: generally regular in shape and longer than the capsule; vesica usually adorned with small denticles and cornuti; also with a plate of minute papillae. Anellus with heavily sclerotised spines, sometimes elaborate, rarely absent.

Female genitalia: Apophyses usually shorter than ductus but posteriores very long in the *castaneae* group. Ductus at colliculum with double sclerotised ring and associated denticulate sac, or with single plate, or without sclerotisation. Bursa



Fig. 3. *Ectoedemia* species. Legs showing position of tibial spurs.

copulatrix: large and variously pectinate; signum double, comprising ovate patches of reticulate cells.

Larvae: may be divided into three groups: leaf-miners usually forming linear tracts terminating in blotches; petiole miners and bark miners both sometimes producing galls.

GENERIC DIFFERENTIAL DIAGNOSIS

Characters which differentiate North American genera of the family Nepticulidae are given.

Ectoedemia Busck, 1907.

Venation: Media of forewing coalescing with Cubitus at base, passing obliquely to Radius at or beyond R_{2+3} and anastomosing to a point beyond middle of wing; R_4 and R_5 separate; Cubitus usually approaching margin; Media of hindwing single. Proximal pair of spurs on hind tibiae sometimes in the middle. Male genitalia with gnathos W- or V-shaped, may vary according to method of mounting; vinculum ring-shaped and without associated lateral bars; tegumen extended into tapering or lobed pseuduncus; uncus absent or weakly membranous; valves inwardly curved distally sometimes with digitate setae; juxta absent; aedeagus regular in shape with elaborate cornuti and usually anellar spines. Female genitalia with or without complex sclerotisation of the ductus and spiculate accessory lobe; apophyses shorter than ductus; signa comprising patches of reticulate cells. Larvae may mine in, or form galls on leaves, petioles, bark or cortex.

Stigmella Schrank, 1802.

Venation: Media of forewing coalescing with Radius at base and anastomosing to a point beyond the middle of the wing; R_4 coincident with R_5 ; Cubitus arising separately, approaching middle of the wing; Media of hindwing single. Forewings usually uniform and dark in colour, with one or two complete fasciae or patches; fringe with diffuse margin. Proximal pair of spurs on hind tibiae above the middle. Male genitalia usually with U-shaped vinculum; tegumen strap-like, articulating with vinculum dorsally; uncus bilobed; juxta, if present, membranous; aedeagus usually flask-shaped, vesica usually with many denticulate cornuti orientated in a ridge and rarely with plate-like cornuti at the anellus. Female genitalia with simple ductus and accessory sac; bursa copulatrix usually without signum, but if present often single and weakly sclerotised. Larvae mining leaves of trees and shrubs and sometimes herbs.

Microcalyptris Braun, 1925.

Venation: Reduced; Media of forewing coalescing with Radius from base and anastomosing to a point beyond the middle of the wing; R_4 coincident with R_5 ; Cubitus vestigial; Media of hindwing single, unbranched. Ground colour of dorsal surface of forewing usually pale and variously irrorate. Proximal pair of spurs on hind tibiae below middle. Male genitalia, with membranous pseuduncus and strongly sclerotised bridge-like uncus; sclerotised gnathos with complex anterior and posterior projections; lateral arms of vinculum usually with associated sclerotisations. Female genitalia with complex sclerotisations of the ductus; posterior apophyses very long, longer than the ductus; signa usually comprising linear row of spinose cells or plates. Larvae mining leaves.

Fomoria Beirne, 1945.

Venation: Media coalescing with Cubitus from base, both passing obliquely to Radius at R_{2+3} and anastomosing to beyond middle of wing; Cubitus becoming obsolete; R_4 and R_5 separate; Media of hindwing single, unbranched. Male genitalia with membranous pseuduncus and uncus as a spatulate sclerotisation; Y- or V-shaped gnathos; saccus weakly bilobed; valves sometimes with dorsal spine; aedeagus regular in shape and usually with complex anellar spines and cornuti. Female genitalia, colliculum with sclerotised funicular antrum or complex plates; simple ductus; signa comprising linear patches of reticulate cells. Larvae often recorded pupating within the leaf-mine.

Obrussa Braun, 1915.

Venation: Media of forewing coalescing with Cubitus at base, both passing obliquely to Radius at R_{2+3} and anastomosing to beyond middle of wing; Media and Cubitus separate terminally; R_4 and R_5 separate; Media of hindwing single. Ventral surface of forewing and dorsal surface of hindwing in males with patch of brightly coloured specialised scales. Proximal pair of tibial spurs below middle of hind tibiae. Male genitalia with ring-shaped vinculum; tegumen extended into tapering pseuduncus; convex saccus; valves blunted distally and each with large dorsal arm projecting transversely to reach opposite side of capsule; vesica with

transverse plate expanded laterally. Female genitalia with plate-like sclerotisation at colliculum; signa comprising ovate reticulate patches. Larvae only known to mine fruits of *Acer* sp.

Glaucolepis Braun, 1917.

Venation: Media of forewing coalescing with Cubitus at base, both passing obliquely to Radius at R_{2+3} and anastomosing to beyond middle of wing; Media and Cubitus separate terminally; R_4 and R_5 separate; Media of hindwing bifurcate. Hindwing of male with patch of brightly coloured specialised scales. Proximal pair of spurs on hind tibiae in the middle. Male genitalia with tegumen extending into tapering pseuduncus, gnathos with large transverse arms and medial dorso-lateral arms fusing terminally; valves markedly bifurcate distally; aedeagus with lateral cornuti extending full length of vesica and digitate distally. Female genitalia with simple ductus; signa comprising linear patches or rows of pectinations. Larvae mining leaves.

Manoneura Davis, 1979 (Replacement for homonymic name *Oligoneura* Davis, 1978).

Venation: greatly reduced; only two branches of Radius present; Media unbranched and arising from stem of R_{4+5} ; Cubitus absent; hindwing extremely slender and Media unbranched. Forewing dark fuscous with a single, narrow, pale golden yellow fascia at distal third. Proximal pair of spurs on hind tibiae near apex. Male genitalia with uncus vestigial; gnathos well developed, complex, consisting of two, largely separate, transverse sclerites of a highly irregular, but symmetrical outline; vinculum broad, quadrate; aedeagus moderately short and stout, with a relatively complex apex and no cornuti. Female genitalia unknown. Presumably a leaf mining genus. The type-species mines *Coccoloba uvifera* (L.).

Artaversala Davis, 1978.

Venation: greatly reduced; Radius unbranched, terminating well short of apex; Media unbranched, extending almost to apex; Cubitus shortened, indistinctly present; hindwing extremely slender and Media unbranched. Forewings with a pale yellow to whitish apex and a single, broad, median fascia. Proximal pair of spurs on hind tibiae near apex. Male genitalia with tegumen reduced to an extremely slender dorsal ring; uncus absent; vinculum well developed and V-shaped valves deeply divided and aedeagus relatively simple, without cornuti. Female genitalia with slender and elongate ductus; bursa copulatrix membranous; signa absent. Larvae mining leaves.

CHECK-LIST TO GENUS, SPECIES AND SUBSPECIES

Ectoedemia Busck, 1907. Type-species by original designation and monotypy: *Ectoedemia populella* Busck.

Zimmermannia Hering, 1940. Type-species by original designation: *Ectoedemia liebwerdella* Zimmermann, 1940: 264.

Dechthiria Beirne, 1945. Type-species by original designation: *Tinea subbimaculella* Haworth, 1828: 583.

populella Busck, 1907
argyropeza downesi Wilkinson & Scoble, 1979¹⁾
canutus Wilkinson & Scoble, 1979
trinotata (Braun, 1914)
marmaropa (Braun, 1925)
platanella (Clemens, 1861)
 maximella (Chambers, 1873)
clemensella (Chambers, 1873)
similella (Braun, 1917)
virgulae (Braun, 1927)
lindquisti (Freeman, 1962)
rubifoliella (Clemens, 1860)
ulmella (Braun, 1912)
nyssaefoliella (Chambers, 1880)
quadrinotata (Braun, 1917)
obrutella (Zeller, 1873)
 bosquella (Chambers in Hayden, 1878a)
acanthella sp.n.
piperella sp.n.
heinrichi Busck, 1914a
castaneae Busck, 1913
phleophaga Busck, 1914b
chlorantis Meyrick, 1928a
mesoloba Davis, 1978

KEY TO THE SPECIES OF NORTH AMERICAN *Ectoedemia*

1. Male genitalia with aedeagus totally lacking anellar projections. Female genitalia with excessively broad anterior apophyses together with unequal signa and no colliculum 2
- Male genitalia with anellar spines on aedeagus. Female genitalia without above combination of characters 3
2. Male genitalia with valves relatively short; as in fig. 28. Female genitalia as in fig. 29. Externals as in figs. 58, ♂, 59, ♀. Larva forms ophistigmatonome on *Nyssa* leaves *nyssaefoliella* (p. 67)
- Male genitalia with valves relatively long; as in fig. 30. Externals as in fig. 60. Female not known specimen 8 (p. 70)
3. Male genitalia with long tapering pseuduncus extending well beyond valves. Female genitalia with strongly sclerotised colliculum in the form of loops. Leaf and petiole miners and petiole gall formers 4
- Male genitalia with large rounded pseuduncus not usually projecting beyond valves and never far beyond. Female genitalia without colliculum or if weakly sclerotised, never in form of loops. Mostly species attacking bark 13
4. Male genitalia with palmate setae on the dorsal surface of valves, (not well developed in one species). Female genitalia with enlarged spinose sac in association with sclerotised colliculum 5
- Male genitalia without palmate setae on valves. Female genitalia without spinose lobe at colliculum 8

¹⁾ The nominate subspecies of *E. argyropeza* (Zeller, 1839) is European and therefore not included here.

5. Male genitalia with small three-pronged setae on dorsal surface of valves as in fig. 15. Hindwing of male without lance-shaped chitinous plate on costal margin. Female genitalia with equal signa, thin colliculum and minute spines on ductus as in fig. 16. Larva makes ophistigmatonome on leaves of *Platanus occidentalis* with long linear tract and large blotch . . . *clemensella* (p. 55)
- Male genitalia with strongly palmate setae on dorsal surface of valves. Hindwing of male with lance-shaped chitinous plate on costal margin. Female genitalia not with above combination of characters 6
6. Male genitalia with strongly bilobed saccus; sharply pointed valves bearing palmate setae with shaft approximately equal to or shorter than digitate processes as in fig. 17c. Female genitalia with small signa, unequal in length and very small spicules on lobe associated with colliculum as in fig. 18. Externals occur in two forms as in figs. 54 and 55. Larva makes ophistigmatonome in leaves of *Quercus* sp. *similella* (p. 56)
- Male genitalia without strongly bilobed saccus; valves not sharply pointed and bearing palmate setae with shaft much longer than digitate processes. Female genitalia with signa approximately equal in length and large spicules on lobe associated with colliculum 7
7. Male genitalia variable, but as in fig. 19; some palmate setae on valves with shaft up to three times length of digitate processes. Female genitalia with signa short and narrow about half length of bursa copulatrix; short rows of spines on lobe associated with colliculum, as in fig. 20c. Externals in two forms as in figs. 56 and 57. Larva makes ophionome in *Corylus* sp. leaves *virgulae* (p. 59)
- Male genitalia as in fig. 13; palmate setae on valves with shaft approximately twice length of digitate processes. Female genitalia with long, broad signa extending almost full length and covering most of bursa copulatrix; very large single spines on the lobe associated with colliculum as in fig. 14c. Externals as in fig. 53. Larva makes ophistigmatonome in leaves of *Platanus* *platanella* (p. 51)
8. Male genitalia with long triangular pseuduncus tapering to point; aedeagus as in fig. 4 or 21. Female genitalia never with spiculate lobe associated with colliculum 9
- Male genitalia with pseuduncus not triangular and rounded at least terminally. Female genitalia with spiculate lobe associated with colliculum 10
9. Male genitalia with dorsal arms of transtillae extending beyond saccus and comparatively small anellar projections; as in fig. 21. Female genitalia with thickened ring of colliculum and relatively long signa; as in fig. 22. Externals as in fig. 43. Larva forms stigmatonome on *Betula* sp. . . *lindquisti* (p. 61)
- Male genitalia with dorsal arms of transtillae broad and short, not extending beyond saccus; large anellar projections; as in fig. 4. Female genitalia with thin ring of colliculum and short signa; as in fig. 5. A petiole gall former on *Populus* sp. *popullella* (p. 41)
10. Male genitalia with small valves only about half length of capsule; anellus with bifurcate spines totalling more than six, as in fig. 11. Female genitalia with large single or double spines on spiculate lobe; signa broad and short; as in fig. 12. Externals as in fig. 52. Larva makes ophistigmatonome on *Rosa* sp.

- *marmaropa* (p. 49)
- Male genitalia usually with valves larger than half capsule length; anellus with four spines. Female genitalia with spiculate lobe not as above; signa long 11
11. Male genitalia with large broad pseuduncus and anellus with four large spines as in fig. 7b. Female genitalia with broad signa tapering distally as in fig. 8. Externals as in fig. 44. Larva is probably a petiole gall-former on *Populus* sp. *canutus* (p. 45)
- Genitalia not as above 12
12. Male genitalia with highly characteristic pseuduncus and shape of anellar spines and valves; as in fig. 9. Female genitalia with long narrow signa and large spines on spiculate lobe of colliculum; as in fig. 10. Externals as in fig. 51. Larva makes ophistigmatonome on *Carya* sp. *trinotata* (p. 46)
- Males non-existent. Parthenogenetic females with genitalia as in fig. 6. Larva mines first in petiole and then makes stigmatonome in lamina of *Populus* sp. *argyropeza downesi* (p. 45)
13. Male genitalia with not more than four large, simple spines near phallotreme; valves markedly incised along inner margin. Female genitalia without any thickening or sclerotisation at colliculum; apophyses usually not markedly different in length 14
- Male genitalia with more than four spines near phallotreme; valves not markedly incised. Female genitalia with colliculum thickened; posterior apophyses usually markedly longer than anteriores 16
14. Male genitalia with saccus strongly concave; anterior arms of valves long; aedeagus with thickened circular band of cornuti; as in fig. 35. Female not known *acanthella* (p. 75)
- Male genitalia not with above combination of characters. Female genitalia as in fig. 24 or 27 15
15. Forewings mottled, indistinct fascia, dull. Male genitalia with valves extending as far as, or further than, extremity of pseuduncus; dorsal arms of transtillae short as in fig. 26. Female genitalia as in fig. 27. Larva makes ophistigmatonome in leaves of *Ulmus* sp. *ulmella* (p. 65)
- Forewing with distinct fasciae, shining silver as in fig. 49. Male genitalia with valves not extending beyond pseuduncus; dorsal arms of transtillae reaching extremity of capsule as in fig. 23. Female genitalia as in fig. 24. Larva makes ophistigmatonome in *Rubus* sp. leaves *rubifoliella* (p. 63)
16. Forewings marked with four small silver patches as in fig. 48. Male genitalia with valves extending well beyond pseuduncus; crown of thorn-like spines present near phallotreme as well as large anellar spines; as in fig. 31. Female genitalia with simple circular thickening at colliculum. Anterior apophyses broad and unusually long reaching as far as posteriores as in fig. 32. Larva makes ophionome with blotch later, in leaves of *Ostrya*, *Carpinus*, *Corylus* and *Betula* sp. *quadrinotata* (p. 70)
- Male genitalia with valves not extending far beyond pseuduncus; anellar spines and cornuti characteristic, similar to figs. 33 and 37. Female genitalia with complex thickened folds at colliculum. Anterior apophyses always much shorter than posteriores 17

17. Male genitalia with valves just reaching end of pseuduncus; as in fig. 37. Female genitalia as in fig. 38 18
 — Genitalia not as above 19
18. Larva mines the bark of *Quercus* sp. Externals as in fig. 61
 *heinrichi* (p. 78)
 — Larva makes galls on twigs of *Castanea*. Externals as in fig. 62
 *castaneae* (p. 80)
19. Male genitalia without swellings or characteristic knobs on inner surface of valves; as in fig. 36. Externals as in fig. 55. Female not known
 *piperella* (p. 77)
 — Male genitalia with characteristic knobs on inner surface of valves. Female genitalia with spicules on colliculum 20

TABLE FOR THE IDENTIFICATION OF *ECTOEDEMA* SPECIES FROM HOST PLANTS
 AND DAMAGE

<i>Ectoedemia</i> species	host genus	host species	site of larval damage	form of larval damage	probable No. of generations	Type locality
<i>populella</i>	<i>Populus</i>	<i>tremuloides</i> <i>grandidentata</i>	petioles	galls	1	—
<i>argyropeza</i> <i>downesi</i>	<i>Populus</i>	<i>tremuloides</i> <i>?grandidentata</i>	1st petioles 2nd lamina	ophionome stigmatonome	1, ♀ only	Ontario
<i>canutus</i>	<i>Populus</i>	<i>balsamifera</i>	petioles	galls	1?	Ontario
<i>trinotata</i>	<i>Carya</i>	<i>cordiformis</i>	lamina	ophistigmatonome	2	Ohio
<i>marmaropa</i>	<i>Rosa</i>	<i>woodsii</i>	lamina	ophistigmatonome	—	Utah
<i>platanella</i>	<i>Platanus</i>	<i>occidentalis</i>	lamina	ophistigmatonome	3	—
<i>clemensella</i>	<i>Platanus</i>	<i>occidentalis</i>	lamina	ophistigmatonome	3	Kentucky
<i>similella</i>	<i>Quercus</i>	<i>palustris</i> <i>rubra</i>	lamina	ophistigmatonome	up to 3	Ohio
<i>virgulae</i>	<i>Corylus</i>	<i>americana</i>	lamina	ophionome	2	Ohio
<i>lindquisti</i>	<i>Betula</i>	<i>papyrifera</i> <i>lutea</i>	lamina	stigmatonome	1	Ontario
<i>rubifoliella</i>	<i>Rubus</i>	sp.	lamina	ophistigmatonome	2	Ohio
<i>ulmella</i>	<i>Ulmus</i>	<i>rubra</i> <i>americana</i> <i>racemosa</i>	lamina	ophistigmatonome	2	Ohio
<i>nyssaefoliella</i>	<i>Nyssa</i>	<i>sylvatica</i>	lamina	ophistigmatonome	2 or 3	Ohio
<i>quadrinotata</i>	<i>Carpinus</i> <i>Corylus</i> <i>Ostrya</i> <i>Betula</i>	<i>caroliniana</i> <i>americana</i> <i>virginiana</i> <i>lutea</i>	lamina	ophistigmatonome	2	Ohio
<i>obrutella</i>	<i>Quercus?</i>	sp.	bark?	—	—	Texas
<i>acanthella</i>	—	—	bark?	—	—	New Jersey
<i>piperella</i>	—	—	bark?	—	—	Arkansas
<i>heinrichi</i>	<i>Quercus</i>	<i>palustris</i>	bark, twigs	spiral ophionome	1	Virginia
<i>castaneae</i>	<i>Castanea</i>	sp.	bark, twigs	galls	2 or 3	Virginia
<i>phleophaga</i>	<i>Castanea</i>	<i>dentata</i>	bark, cambium	ophionome	1	Virginia
<i>chlorantis</i>	—	—	bark?	—	—	Ontario
<i>mesoloba</i>	—	—	bark?	—	—	Florida

For *Amelanchier* see *nyssaefoliella* description.

20. Male genitalia with simple rounded knob on inner side of valves; valves not reaching beyond pseuduncus; as in fig. 42. Externals as in fig. 50. Female not known *mesoloba* (p. 85)
- Male genitalia different from above and valves extending beyond pseuduncus. Only females known in one species 21
21. Genitalia as in figs. 33 and 34. Male genitalia with three small knobs on inner side of valves. Anterior arms of valves long extending beyond capsule. Externals as in fig. 47 *obrutella* (p. 72)
- Genitalia and externals not as above 22
22. Genitalia as in figs. 39 and 40. Male genitalia with characteristic knobs on inner side of valves. Dorsal arms of transtillae short. Female genitalia with comparatively simple ductus bursae. Externals in fig. 63. Larva makes a bark ophionome in *Castanea* sp. *phleophaga* (p. 81)
- Female genitalia as in fig. 41. Complex thickening in ductus bursae. Externals as in fig. 46. Male not known *chlorantis* (p. 84)

THE POPULELLA GROUP

The North American *Ectoedemia* can be divided into four species groups. The *populella* group contains the first five species. All males have a pointed pseuduncus except *argyropeza downesi* where males are not known to occur. They lack the multi-branched setae on the inner sides of the valves found in the *platanella* group. All females have a sclerotised ring-shaped colliculum and associated denticulate patch. *E. lindquisti* could belong in this group but it does not have the same characteristic anellar processes and has perhaps more affinity with the *rubifoliella* group.

This group includes all the species which attack petioles: *populella*, *argyropeza* and probably *canutus*, as well as the leaf miners *trinotata* and *marmaropa*.

***Ectoedemia populella* Busck** (figs. 4, 5)

Ectoedemia populella Busck, 1907: 98.

Ectoedemia populella Busck; Braun, 1917: 197.

Ectoedemia populella Busck; Braun in Forbes, 1923: 83.

Ectoedemia populella Busck; McDunnough, 1939: 107 (no. 9783).

Ectoedemia populella Busck; Borkowski, 1972: 697.

Ectoedemia populella Busck; Wilkinson & Scoble, 1979: 74.

Description. — Fully described from Canada by Wilkinson & Scoble (1979).

Diagnosis. — Usually larger than the other members of the genus studied here and characterised by the cupreous reflections of forewings. Differs from *canutus* in the valves, which are shorter and broader, and the gnathos, which is not bifid laterally, in *populella*. The gall forming habit differentiates the larvae from those of *argyropeza* which produce more irregular callus tissue.

Distribution. — USA: — New York, New Hampshire, Massachusetts, Ohio (Braun). Canada: — Ontario, Manitoba.

Material examined. — In USNM —USA: New York, Monroe Co.; on *Populus*

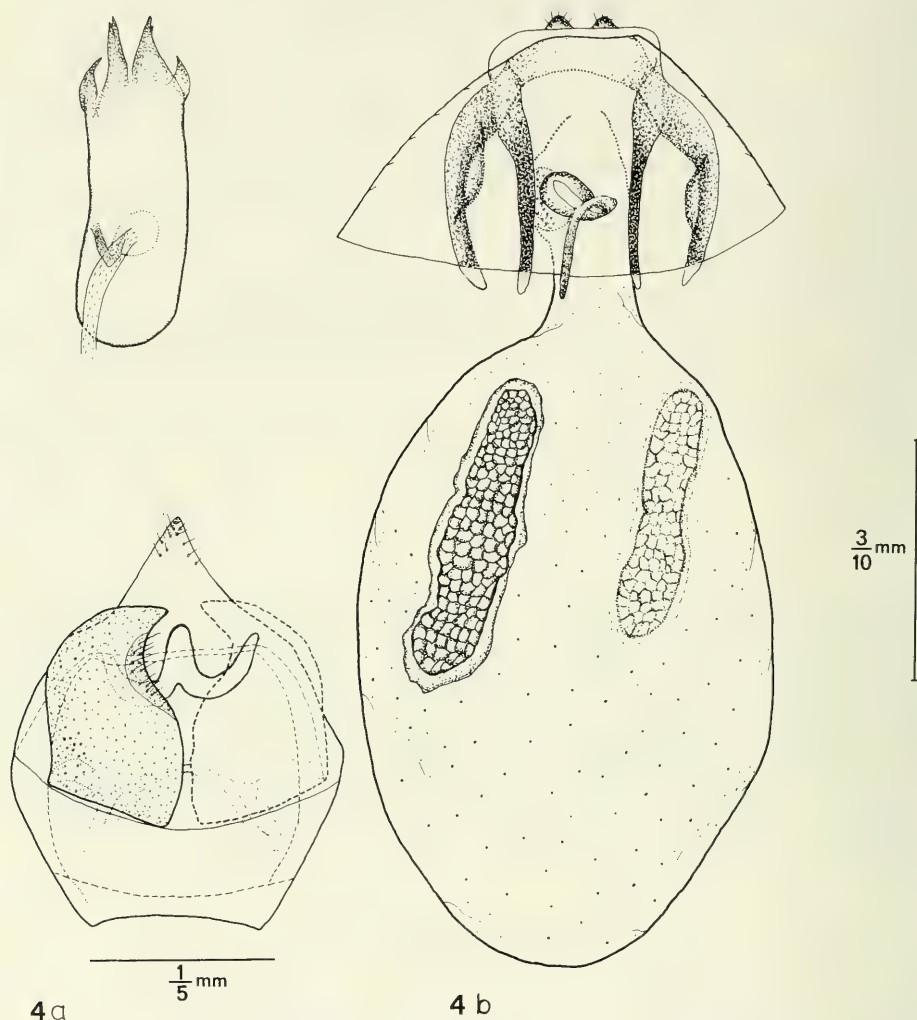


Fig. 4. *Ectoedemia populella* Busck, ♂ (a) and ♀ (b) genitalia.

sp.; 8 ♂, 2 ♀, 2 ex., 1—16.v.1948 (Kimball). "Awene, Man."; 1 ♀, 24.v.1921 (Criddle). In CNC — Canada: Ontario, Bells Corner; 2 ♀, 30.v.1965 (Sattler); Lake Erie, Cultus; on *Populus tremuloides*; 1 ♂, 1.iii.1962; La Passe; on *Populus* sp.; 1 ♂, 10.xii.1970; 1 ♂, 1.iii.1971 (Lewis); Minden, 1 ♂, 27.v.1931 (McDunnough). In SOO — Ontario, Bradford; on *Populus tremuloides*, 1 ♂, 2 ♀, 1 ex., 28.v.1970; on *Populus grandidentata*, 2 ♂, 5 ♀, 3 ex., 28.v.1970; Nestor Falls; on *Populus tremuloides*; 1 ♂, 11.ii.1963, 1 ♂, 7.iii.1963.

Galls examined: In FIS — Canada: Ontario, Bradford; several galls on *Populus grandidentata* preserved in alcohol; 16.vii.1969, 695—2125—01; Uxbridge; several galls on *Populus tremuloides* preserved in alcohol; 11.ix.1969, 675—4171—01.

Syntypes. 1 ♂, 1 ♀, have also been examined from the collection in the Transvaal museum. However a lectotype is not here designated. This will be done

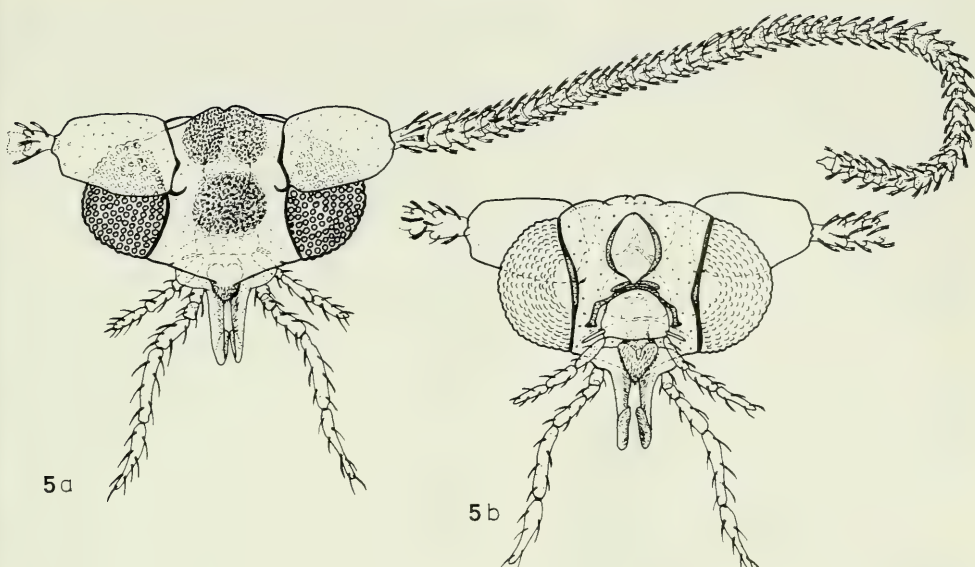


Fig. 5. *Ectoedemia populella* Busck, head, anterior (a) and posterior (b) view ($\times 70$).

in "The Moths of North America north of Mexico" from the type-series in the USNM.

Biology. — The larvae form galls on the leaf petioles of *Populus tremuloides* and *P. grandidentata*. These are swellings situated close to the lamina. The larvae mature in October and the imagines emerge in May of the following year (Busck, 1907; Braun, 1917). The specimens in the CNC that emerged earlier than this were probably "forced" in the laboratory.

Voltinism. Univoltine in both Canada and the U.S.A.

***Ectoedemia argyropeza* (Zeller)** (fig. 6)

Lyonetia argyropeza Zeller, 1839: 215.

Nepticula argyropeza (Zeller); Zeller, 1848: 320.

Nepticula argyropeza (Zeller); Petersen, 1930: 78.

Nepticula argyropeza (Zeller); Hering, 1951: 232.

Nepticula turbidella Zeller *sensu* Herrich-Schäffer, 1853: 357; Downes, 1968: 1078.

Dechtria argyropeza (Zeller); Beirne, 1945: 205.

Dechtria argyropeza (Zeller); Emmet, 1971: 242.

Dechtria argyropeza (Zeller); Borkowski, 1972: 698.

Stigmella argyropeza (Zeller); Borkowski, 1969: 107.

Stigmella (sic) *turbidella* (Zeller) *sensu* Herrich-Schäffer, 1853: 357; Cochaux, 1969: 12.

Trifurcula (*Ectoedemia*) *argyropeza* (Zeller) *sensu* Johansson, 1971: 245.

Ectoedemia argyropeza (Zeller); Emmet, 1976: 189.

Ectoedemia argyropeza (Zeller); Wilkinson & Scoble, 1979: 77.

Description. — Fully described from Canada by Wilkinson & Scoble (1979) and is regarded as being represented by two subspecies. The female genitalia of the subordinate subspecies are shown in fig. 6.



6

Fig. 6. *Ectoedemia argyropeza* (Zeller), ♀ genitalia.

Diagnosis. — Differs from *canutus* in the forewing ground colour, which is generally darker and less irrorate in *argyropeza*. The wider and less pointed ovipositor distinguishes the genitalia from those of *canutus*.

Discussion. — Closely related to the following species, *canutus*, in both externals and genitalia.

***Ectoedemia argyropeza argyropeza* (Zeller)**

Diagnosis. — Differs from the subordinate subspecies in the paler forewing ground colour. Only known in Europe whilst *downesi* is North American.

Material examined. — ♀ Lectotype: "Gross Glogau, Silesia, Zeller 183: 101291,

Zeller Collection Walsingham Collection 1910—427, 101291, *Argyropeza* Zeller 1839: 215. *Lyonetia* A. *Bucculatrix* Isis 1839: 215"; in BM (NH).

Other specimens: In BM (NH) — Locality as lectotype; 1 ♀, 22.v.1853 (Zeller); Walsingham Coll. ex Zeller Coll., 1910—427; 101289.

***Ectoedemia argyropeza downesi* Wilkinson & Scoble**

Ectoedemia argyropeza downesi Wilkinson & Scoble, 1979: 80.

Diagnosis. — Differs from the nominate subspecies in the ground colour of the forewings which are grey and heavily irrorate with purplish brown scales distally. Occurs only as parthenogenetic females.

Distribution. — Canada: — Ontario, Quebec.

Material examined. — ♀ Holotype: Canada: "Ontario, Ottawa"; on *Populus tremuloides*; 29.v.1969 (Downes); in CNC. Paratypes: In CNC — data as holotype; 12 ♀, 29.v.1969, 5 ♀, 28.v.1968, 2 ♀, 31.v.1968, 4 ♀, 4.vi.1968, 2 ♀, 7.vi.1968 (Downes). Ontario, Ottawa; on *Populus* sp.; 20 ♀, 6.v.1941 (Freeman); Ste. Anne de Bellevue, P.Q., Morgan Arboretum; 4 ♀, 1.vi.1969 (Sheppard).

Biology. — Egg. Laid on the petioles of *Populus tremuloides* and *P. grandidentata*. The number of eggs per leaf depends on leaf size and the position of the leaf on the tree: eggs are more abundant on leaves at lower levels.

Mine. Begins as a petiole mine and later becomes of stigmatonome in the leaf blade. Whilst a certain amount of callus tissue is formed in the petiole of *Populus tremuloides*, in *P. grandidentata* this may, apparently, block the mine, preventing the larvae from developing; the larvae seldom reach maturity on this host. A green zone extends along the mined portions of the leaf-blade, even after the leaf has turned yellow and fallen to the ground ("green-islands" of Hering).

Larva. Remains in the mine until after leaf fall in late October and early November. Over-winters in ground litter or soil in cocoon.

Pupation. Occurs in early spring.

Voltinism. One generation per year.

Other notes. Cochaux (1969: 12) suggests that the very high populations of this species may be due to the parthenogenetic reproduction.

***Ectoedemia canutus* Wilkinson & Scoble**

(figs. 7, 8, 44)

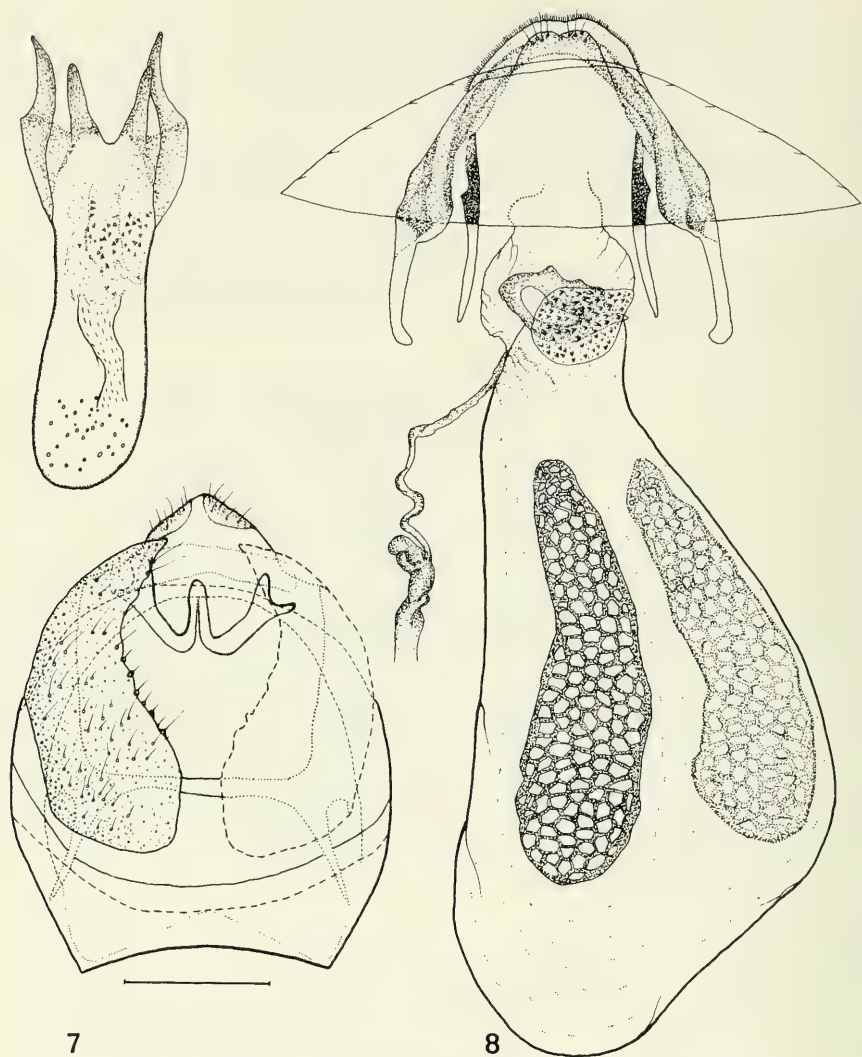
Ectoedemia canutus Wilkinson & Scoble, 1979: 81.

Description. — Fully described by Wilkinson & Scoble (1979).

Diagnosis. — Generally darker than *argyropeza argyropeza* and more uniformly irrorate than *argyropeza downesi*. The valves of the male *canutus* are larger and narrower than in *populella*. It also differs in the bifid nature of the gnathos.

Distribution. — USA: — California. Canada: — Ontario.

Material examined. — ♂ Holotype: Canada: Ontario, Angus; on *Populus balsamifera*; 4.iii.1969, 68.5.3397.01; SOO no. 9; in SOO. Paratypes: In SOO — Canada: data as in Holotype; 6 ♂, 3 ♀, 3—11.iii.1969; 5 ♂, 1 ♀, 2 ex., 28.v.1970, 705.0074.01.



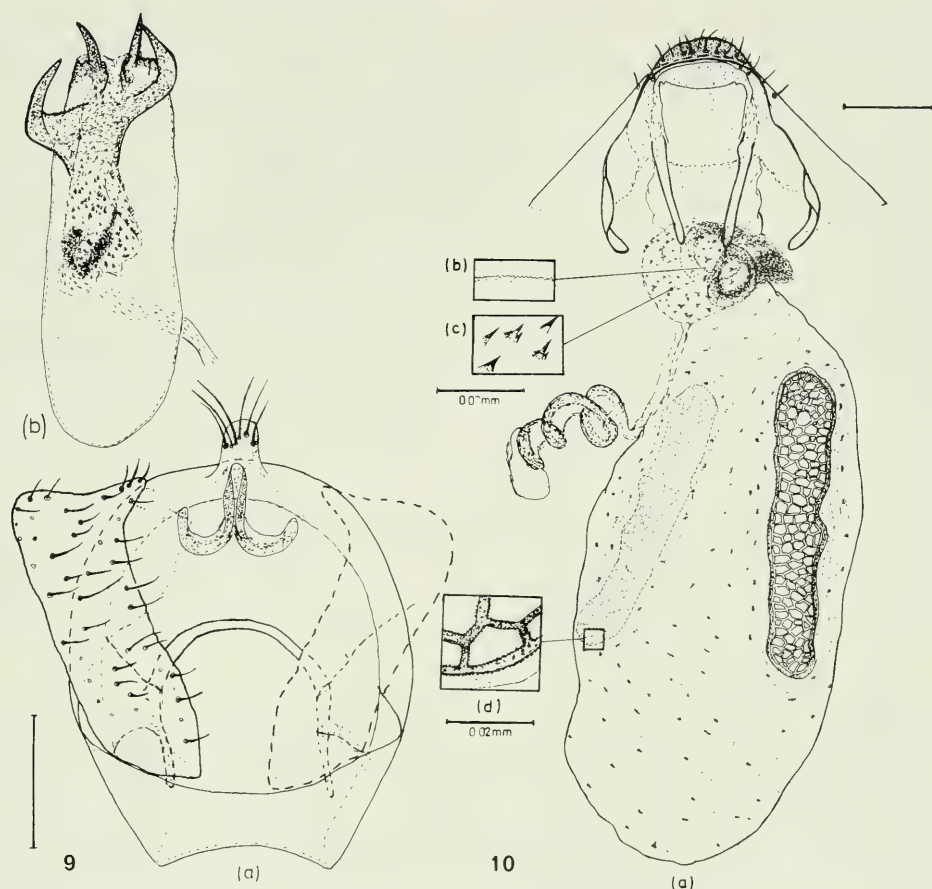
Figs. 7, 8. *Ectoedemia canutus* Wilkinson & Scoble, ♂ (7) and ♀ (8) genitalia.

Other material. — USA: 4 ♂, 2 ♀, California, Los Angeles Co., Big Rock Wash., near Lovejoy Buttes, T6N R9W Sec 30, elev 2770', 31.iii.1972 (Donahue).

Biology. — Probably a gall former on the petioles of *Populus balsamifera*. Galls examined: There are several galls on petioles, preserved in alcohol, which are indistinguishable from those of *populella*. The host and locality suggest that they may belong to *canutus*. In SOO — Canada: Ontario, Angus; on *Populus balsamifera*; 3.ix.1968 (Bowser).

***Ectoedemia trinotata* (Braun) comb. nov.**
(figs. 9, 10, 51, 66)

Nepticula trinotata Braun, 1914: 18.



Figs. 9, 10. *Ectoedemia trinotata* (Braun), ♂ (9) and ♀ (10) genitalia.

Nepticula trinotata Braun; Braun, 1917: 169.

Nepticula trinotata Braun; Braun in Forbes, 1923: 87.

Nepticula trinotata Braun; McDunnough, 1939: 107 (no. 9723).

Description. — External features: ♂. Head: palps whitish; antennae dark brown; tuft on front of head ochreous, vertex paler; eye-caps shining white; collar off-white. Thorax very dark grey-brown with purple and blue reflections. Abdomen grey, shining metallic grey beneath. Forewings: ground colour of dorsal surface very dark brown, basal third with purple reflections, apical two thirds irrorate, with base of each scale greyish; fringe whitish, shining silver, with apical band of dark brown wing scales; small diffuse antemedial spot on costal margin which is occasionally eclipsed by greyish reflections when viewed from certain angles, followed by two distinct postmedial spots, shining silver, one at each margin. Hindwings: ground colour and fringe brownish grey, shining metallic grey. Legs dark brown, shining metallic grey behind. Fig. 51.

Female. As ♂ except for a pair of external convex pockets ventro-medially placed on the fourth abdominal segment.

Wing expanse: ♂: 3.8—5.3 mm (6 specimens); ♀: 4.4—5.4 mm (7). Holotype: 5.0 mm.

Genitalia: ♂ (fig. 9). Pseuduncus with a single lobe as in fig. 9 (a). Gnathos: W-shaped as in fig. 9 (a) with long medial process; dorso-lateral arms short. Vinculum: lateral arms broad; ventral plate very narrow. Saccus approximately five times the width of the ventral plate, weakly bilobed. Valves not reaching beyond the pseuduncus, quadrate and with a triangular inner process, arising distally. Transtillae: an inverted U-shape as in fig. 9 (a); lateral arms broad and short; ventral arms narrow, reaching just beyond ventral plate; transverse bars fused to form a narrow arcuate strap. Aedeagus: regular in shape, approximately equal to length of the capsule; vesica with cornuti as many small denticles evenly distributed and with plate of minute papillae in the shape of figure eight; anellus comprising a pair of lateral spines and a pair of large canine tooth-like spines.

Female (fig. 10). Ductus bursae short with colliculum as a sclerotised double ring associated with a large lobe bearing scattered spicules as in fig. 10 (c). Accessory duct arising from area of dilation of the ductus, distally spiralled. Bursa copulatrix: very large and covered with small scallop-shaped chains of pectinations on striations of the bursa; signum double, comprising a pair of long cellular patches, equal in area as in figs. 10 (a) and 10 (d). Anterior apophyses long and broad. Posterior apophyses straight and broad, equal in length to the anteriores.

Host plant: *Carya cordiformis* (Hickory).

Mine: An upper surface ophistigmatonome.

Diagnosis. — Easily differentiated from other members of the genus in this study by the forewing markings, the lobe of the pseuduncus and the form of the transtillae. The mine differs from the serpentine tract produced by *Stigmella juglandifoliella* (Clemens) also found on *Carya* spp.

Discussion. — Although the externals resemble those of *quadrinotata* there is no similarity in the genitalia. The form of the colliculum in the female relates this species to several members of the genus.

Distribution. — USA: — Ohio, Arkansas, Illinois.

Material examined. — ♀ Holotype: USA: "B.499; Cincinnati, Ohio, Annette F. Braun, i, 3.viii.1913; Type Collection of Annette F. Braun; *Nepticula trinotata* Braun Type"; on *Carya* sp.; slide no. 144-PJN; in ANS. Paratypes: In ANS data as holotype; 3 ♀, 1,2,3.viii.1913, 1 ♂, 1 ex., 31.vii.1913, 2 ♂, 8,11.viii.1913, B.499 (Braun). In USNM — same data as Holotype: 2 ♀, 6,15.viii.1913, B.499 (Braun); slide nos: 145-PJN, 146-PJN, CNC 3480.

Other specimens: In ANS — USA: Ohio, Cincinnati; on *Carya* sp.; 1 ♀, 15.viii.1914, 1 ♂, 17.vi.1917, 1 ♂, 1 ♀, 10.vii.1917, B.499 (Braun). In USNM — Arkansas, Washington County; 1 ♂, 10.vii.1966 (Hodges). Illinois, Putnam County; 2 ♂, 1 ♀, 1 ex., 21.vii.1962, 1.vi.1963, 6.viii.1964, 12.vii.1965.

Mines examined: In ANS — USA: Ohio, West Fork Woods; 4 mines on *Carya* sp.; 15.vii.1909, B.499 (Braun).

Biology. — Egg. Laid on the upper or lower surface, usually near a vein.

Mine. At first a very narrow, much contorted linear mine which rapidly enlarges into an extensive blotch. The frass is scattered throughout the mine (fig. 66).

Larva. Emerges from the mine on the upper surface of the leaf.

Pupa. Cocoon pale brown in colour.

Voltinism. Bivoltine in Ohio, adults emerging from the overwintering generation in June and from the other generation in late July and early August.

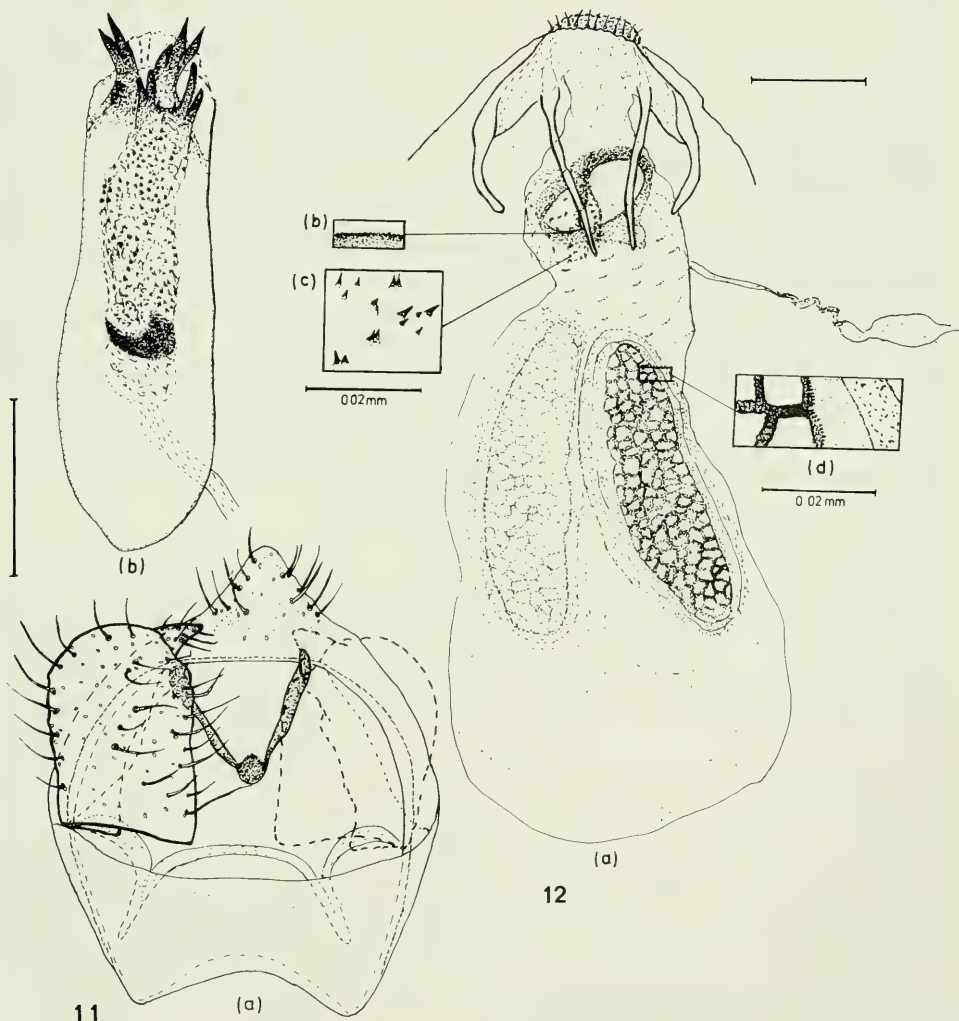
***Ectoedemia marmaropa* (Braun) comb.n.**

(figs. 11, 12, 52, 67)

Nepticula marmaropa Braun, 1925: 225.

Nepticula marmaropa Braun; McDunnough, 1939: 107 (no. 9778).

Description. — External features: ♂. Head: palps buff-grey; antennae grey; tuft on front of head ochreous, vertex darker; eye-caps shining white; collar pale ochreous. Thorax dark brown with gold and bronze reflections. Abdomen brown with



Figs. 11, 12. *Ectoedemia marmaropa* (Braun), ♂ (11) and ♀ (12) genitalia.

gold reflections above, shining metallic grey beneath. Forewings: ground colour of dorsal surface dark brown with bronze and gold reflections, becoming irrorate distally, each scale being darker at the tip; fringe grey, shining silver at apex, with an apical band of dark brown wing scales; basal patch extending to one-fifth, dusted with grey, followed by a single postmedial fascia, convex and shining silver. Hindwings: ground colour and fringe brownish grey, shining metallic grey. Legs dark brownish with silver reflections on both surfaces. Fig. 52.

Female. As ♂ except for a pair of external convex pockets ventro-medially placed on the fourth abdominal segment.

Wing expanse: ♀: 4.2—4.4 mm (3 specimens). Holotype ♂: 4.0 mm.

Genitalia: ♂ (fig. 11). Pseuduncus with a single tapering lobe, rounded terminally. Gnathos: W-shaped as in fig. 11 (a); transverse ventral plate with a short central boss; dorso-lateral arms long and thin. Vinculum: lateral arms broad; ventral plate narrow. Saccus approximately twice width of ventral plate, bilobed. Valves reach not much further than base of pseuduncus, quadrate with a short, broad style and very broad cuiller. Transtillae: broadly W-shaped as in fig. 11 (a); lateral arms narrow; ventral arms straight, reaching beyond the ventral plate; transverse bars fused to form a narrow strap. Aedeagus: flask-shaped, just greater than length of the capsule; vesica with cornuti as many small denticles evenly distributed and with a pair of large digitate cornuti at the phallotreme, also with a cup-shaped plate of minute papillae; anellus comprising a pair of large plates with bifurcate spines.

Female (fig. 12). Ductus bursae short with colliculum as a sclerotised double ring associated with a small lobe bearing scattered spicules as in fig. 12 (c). Accessory duct arising from dilation of the ductus, spiral medially. Bursa copulatrix: very large, covered with short chains of pectinations proximally; signum double, comprising a pair of equal, ovate cellular patches as in figs 12 (a) and 12 (d). Anterior apophyses long and arcuate. Posterior apophyses straight and narrow reaching beyond the anteriores.

Host plant: *Rosa woodsii*.

Mine: An upper surface ophistigmatonome.

Diagnosis. — The lustrous basal patch of the forewings separates this species from any other in the genus with a single fascia. Resembles *lindquisti* in the overall form of the male genitalia but differs in the nature of the valves and the more complex anellar processes in *marmaropa*. The aedeagus is larger than that of *lindquisti*.

Discussion. — Related to several members of the genus in the form of the female genitalia.

Distribution. — USA: — Utah, Wyoming. Ohio?

Material examined. — ♂ Holotype: USA: "B.1191; Cache Co., Utah, i.23.iv.1925. Annette F. Braun; Type Collection of Annette F. Braun; *Nepticula marmaropa* Braun Type"; on *Rosa woodsii*; slide no. 131-PJN; in ANS. Paratypes: In ANS data as Holotype; 2 ♀, 3, 17.iv.1925 (Braun); slide nos: 132-PJN, 133-PJN.

Other Specimens: In ANS — USA: Wyoming, Phelps Lake, Grand Teton National Park; 1 ♀, 17.v.1935, B.1462 (Braun).

Mines Examined: In ANS — USA: Ohio; 2 mines on *Rosa woodsii*; no date, B.1191 (Braun).

Biology. — Egg. Laid on the lower surface of the leaf and, in both cases observed, next to the midrib.

Host. The specimen from Wyoming bears the A. F. Braun breeding number B.1462; the record and the material cannot be located for identification of the host plant.

Mine. Begins as a very narrow linear mine but abruptly enlarges into a blotch which may consume half the area of the leaf. The frass is scattered throughout the blotch (fig. 67).

Larva. Emerges on the upper surface of the leaf.

Pupa. Cocoon at first bluish green, later turning dark brown in colour.

THE PLATANELLA GROUP

The following four species — *platanella*, *clemensella*, *virgulae* and *similella* — can be separated to form a discrete group, when this is seen to be an advantage.

The males have the same tapering pseuduncus and W-shaped gnathos of the last group; the aedeagus has very pronounced anellar lobes. The most notable character is the presence of multi-branched setae on the inner surface of the valves — more weakly developed in *clemensella*.

The colliculum is present as a single or double sclerotised ring in females.

Externally there is a lance-shaped chitinous plate along the fore-edge of the hind wing in the males, except in *clemensella*. Another minor feature is the forewing marking. All have a biconcave fascia reduced in some to a pair of marginal streaks. All are leaf-miners.

***Ectoedemia platanella* (Clemens)** (figs. 13, 14, 53, 68)

Nepticula platanella Clemens, 1861: 83.

Nepticula platanella Clemens; Clemens, 1862a: 133.

Nepticula plantanella (sic) Clemens; Clemens, 1862b: 149, 150.

Nepticula platanella Clemens; Clemens, 1865: 146.

Nepticula platanella Clemens; Clemens in Stainton, 1872: 173, 183, 192.

Nepticula platanella Clemens; Chambers, 1873: 125.

Nepticula platanella Clemens; Chambers in Hayden, 1878b: 158.

Nepticula platanella Clemens; Dyar, 1903: 546.

Nepticula platanella Clemens; Busck, 1903: 209.

Nepticula platanella Clemens; Braun, 1917: 187.

Nepticula platanella Clemens; Braun in Forbes, 1923: 92.

Nepticula platanella Clemens; McDunnough, 1939: 107 (no. 9760).

Ectoedemia platanella (Clemens); Wilkinson & Scoble, 1979: 89.

Nepticula maximella Chambers, 1873: 126 (syn. by Braun, 1917: 187).

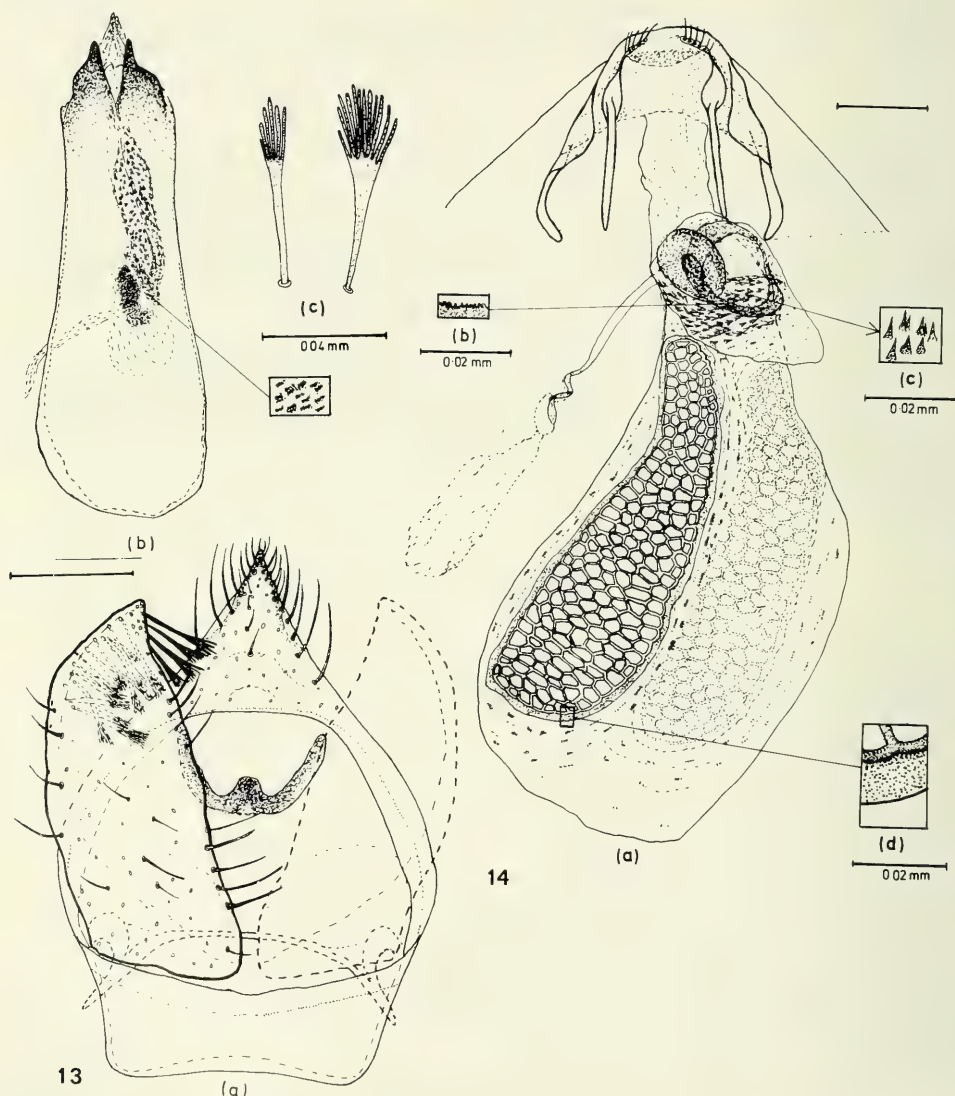
Nepticula maximella Chambers; Chambers in Hayden, 1878b: 158.

Nepticula maximella Chambers; Dyar, 1903: 546.

Description. — External features: ♂. Head: palps buff; antennae dark brown; tuft on front of head pale ochreous, vertex darker; eye-caps shining white; collar

pale ochreous. Thorax and abdomen dark greyish brown. Forewings: ground colour of dorsal surface dark brown with bronze lustre; fringe whitish, with an apical band of dark brown wing-scales; a pair of white, medial streaks marginally, which are occasionally linked in the middle by a few white scales to form a complete fascia. Hindwings: ground colour and fringe pale grey; a lance-shaped chitinous plate extends along the fore edge to the middle of the costa. Legs buff, with areas of dark brown. Fig. 53.

Female. As ♂ except that chitinous plate of hindwings is absent. With a pair of convex, external pockets ventro-medially placed on the fourth abdominal segment.



Figs. 13, 14. *Ectoedemia platanella* (Clemens), ♂ (13) and ♀ (14) genitalia.

Wing expanse: ♂: 4.0—6.8 mm (25 specimens); ♀: 3.6—6.8 mm (23). Neotype: 6.0 mm.

Genitalia: ♂ (fig. 13). Pseuduncus with a single tapering lobe. Gnathos: W-shaped as in fig. 13 (a); transverse ventral plate with broad central boss; dorso-lateral arms long. Vinculum: lateral arms narrow; ventral plate narrow. Saccus more than twice the width of the ventral plate and weakly bilobed. Valves: not reaching beyond the pseuduncus, tapering slightly; with terminally digitate setae on the dorsal surface distally as in fig. 13 (c). Transtillae: with short, narrow lateral arms; ventral arms reaching beyond the ventral plate; transverse bars fused to form a continuous narrow strap. Aedeagus: approximately equal to length of the capsule, regular in width; vesica with cornuti as many small denticles evenly distributed and with a comma-shaped plate of minute papillae; anellus comprising two pairs of simple spines as in fig. 13 (b).

Female (fig. 14). Ductus bursae long, colliculum as a sclerotised double ring ring with serrate inner margin, as in fig. 14 (b), and with associated lobe bearing scattered spicules as in fig. 14 (c). Accessory duct arising from area of dilation of the ductus, spiral distally. Bursa copulatrix very large and covered with small scallop-shaped chains of pectinations on striations of the bursa; signum double, comprising a pair of long reticulate patches, equal in area as in figs 14 (a) and (d). Anterior apophyses long and broad. Posterior apophyses straight and narrow, equal in length to the anteriores.

Host plant: *Platanus occidentalis*.

Mine: An upper surface ophistigmatonome.

Diagnosis. — Usually larger and browner than *clemensella* and the males have the hindwing scale which is absent in *clemensella*. The linear portion of the mine is longer in *clemensella* and the enlargement into the blotch more gradual than in *platanella*. The male genitalia differ in the nature of the saccus, which is markedly bilobed, and the scales of the valves, which are shorter and less furcate, in *clemensella*. The female genitalia may be separated from those of *similella* and *virgulae* by the spines of the accessory sac, which are large and single, in *platanella*.

Discussion. — Clemens (1861: 83) originally described this species from mines found on the "Button-Wood Tree or Sycamore". In 1862 he described an adult caught at light which he gave the same name and labelled as type. The original mine(s) described actually constitute the type(s) but they have never been mentioned in print and are no longer extant. To resolve this problem a neotype is here designated. It is the specimen described by Clemens and also Busck (1903: 209). Chambers (1873: 126) described adults which he named *maximella* and associated them with a mine earlier described by Clemens (1862b: 149) as Sycamore miner no. 3 and thought to be the product of a different species. In spite of this, Braun (1917: 187) later synonymised *maximella* with *platanella* although she gave no reasons. The mine of *maximella* is characteristic in the quadrate nature of the terminal blotch as opposed to the round blotch of *platanella* material. Examination of the genitalia shows that the male syntype of *maximella* lacks the bifurcate anellar process and the saccus is less markedly bilobed than in examples of *platanella*. However, this preparation is distorted so we do not regard the differences observed to be sufficient to withdraw *maximella* from synonymy at this stage.

Distribution. — USA: — Ohio, New Jersey, Washington D.C., Pennsylvania, Kentucky, Massachusetts, Florida, Alabama. Canada: — Ontario.

Material examined. — Designated as neotype the ♀ examined by Busck (1903): USA: "Type no. 7494, *Nepticula platanella* B. Clemens, Specimen no. 118, A.B. 1903"; slide no. CNC 3464; in ANS. Syntypes of *maximella*: 1 ♂, "2) *Nepticula maximella* Cham."; Type no. 525 USNM; slide no. CNC 3477; 1 ♀, "2) Cham. Type"; slide no. CNC 3502; in USNM.

Other Specimens: In ANS — USA: Ohio, Cincinnati; on *Platanus* sp.; 1 ♀, 12.vii.1909, 2 ♂, 13.vii.1909, 1 ♂, 29.vii.1909, 1 ♀, 4.vii.1911, 1 ♂, 1 ♀, 5.vii.1911, 1 ♀, 29.vii.1913, B.348 (Braun); 1 ♀, 30.vii.1903 (Braun). Ohio, Cincinnati; 5 ♂, 2 ♀, 27.vi.1916 (Braun); 1 ♂, "Lot 72", (Heimbach). No locality data; 3 ♀ 1, "2, *Nepticula maximella* Cham = *N. platanella* Clem". In USNM — Ohio, Cincinnati; on *Platanus* sp.; 1 ♀, 10.vii.1909, B.348 (Braun). Ohio, Cincinnati; 1 ♂, 31.vii.1903, 1 ♂, 4.viii.1903, 1 ♀, 22.v.1906, 5 ♂, 1 ♀, 6 ex., 27.vi.1916 (Braun). No locality data; on *Platanus* sp.; 1 ♂, 17.vi.1885, 1 ♀, 5.v.1885 (Murfeldt); 1 ♂, "1) *N. platanella* Clem. Ch."; 1 ♀, 5.vi.1885 (Fernald Coll.). Washington, D.C.; on *Platanus* sp.; Aug. 1902 (Busck); 12 ex., 15.vii.1908. Massachusetts, Barnstable; 1 ex., 28.vii.1952 (Kimball). Alabama, Open Pond Cpgd., S. Andalusia, Covington Co.; 1 ♂, 18.iv.1976 (Heppner). Florida, Oneco, Manatee Co.; 1 ♂, 3 ex., 5—14.v.1953, 7.vi.1953 (Dillman). Siesta Key, Sarasota Co.; 2 ex., 30.iv. + 1.vi.1957 (Kimball). Pensacola; 1 ♀, 7.ix.1961 (Hills). Near Gainesville, Alachua Co., Archer Road Lab.; 1 ♂, 3 ex., 13.vi.1975, 4—5.v.1976 (Heppner); Gainesville; 1 ex., 11.xi.1974 (Greenbaum). Archbold Biol. St., Lake Placid, Highlands Co.; 2 ♂, 1 ♀, 6 ex., 1—8.v.1975 (Heppner). In CNC — Canada: Ontario, Normandale; on *Quercus rubra*; 1 ♂, 16.vi.1962 (Freeman and Lewis).

Mines examined: In ANS — USA: Ohio, Madisonville Swamp; 1 mine on *Platanus occidentalis*; 7.ix.1909, B.561¹⁾ (Braun).

Biology. — Egg. Laid on the lower surface of the leaf, sometimes near a vein.

Host. Braun reports that the mines of this species are abundant on the leaves of *Platanus* spp. and that adults may be found in large numbers on the trunks of the host. The single male bred from *Quercus rubra* is the only record of the species from that host.

Mine. Begins as a much contorted linear mine which is usually filled with frass. Several days before pupation, the mine abruptly enlarges into an almost circular blotch, which often eclipses the earlier portion of the mine. The frass is scattered evenly throughout the blotch (fig. 68).

Larva. Pale green in colour, emerges on the upper surface of the leaf.

Pupa. The cocoon is brown in colour.

Voltinism. Braun (1917) reports that there are three generations per year; the material examined here shows specimens to have emerged from early May to late July and reaching a peak in late June and early July. One specimen from Florida is dated November.

¹⁾ Some specimens of *Stigmella apicalbella* comb. n. were incorrectly labelled by Braun with this same breeding number.

***Ectoedemia clemensella* (Chambers)**
(figs. 15, 16)

Nepticula clemensella Chambers, 1873: 125.

Nepticula clemensella Chambers; Chambers in Hayden, 1878b: 157.

Nepticula clemensella Chambers; Dyar, 1903: 545.

Nepticula clemensella Chambers; Braun, 1917: 188.

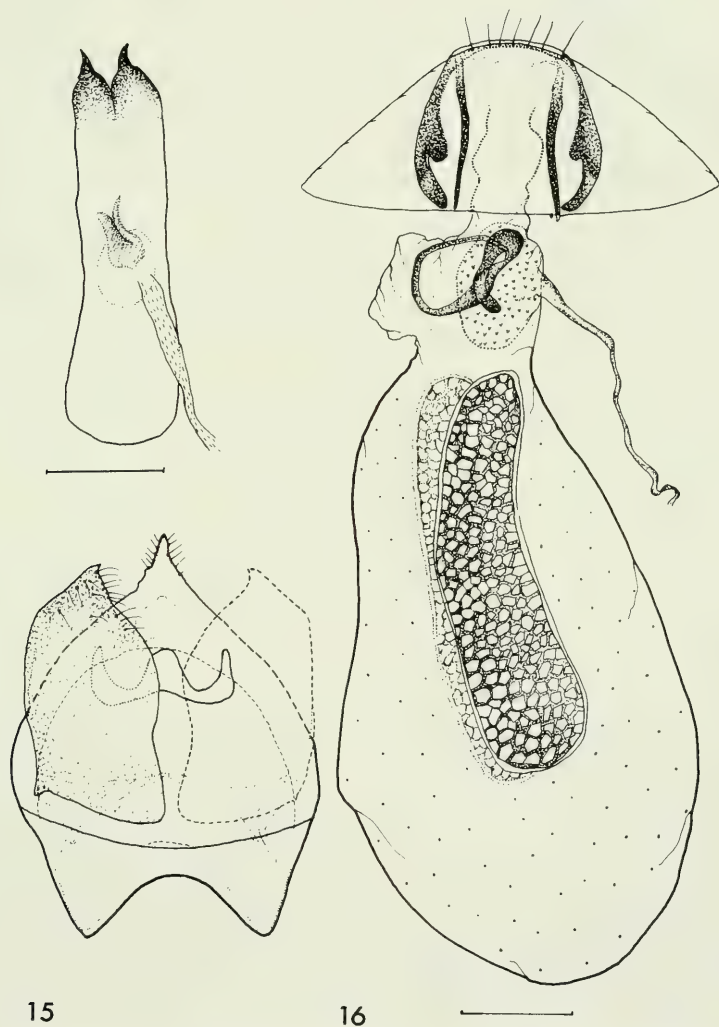
Nepticula clemensella Chambers; Braun in Forbes, 1923: 93.

Nepticula clemensella Chambers; McDunnough, 1939: 107 (no. 9761).

Ectoedemia clemensella (Chambers); Wilkinson & Scoble, 1979: 86.

Description. — Fully described from Canada by Wilkinson and Scoble (1979).

Diagnosis. — Generally smaller and paler in colour than *platanella*; the males lack the chitinous plate of the hindwing which is found in *platanella*, *similella* and



Figs. 15, 16. *Ectoedemia clemensella* (Chambers), ♂ (15) and ♀ (16) genitalia.

virgulae. The setae of the valves are smaller and less furcate than those of any other species in the group and the saccus more markedly bilobed than in *similella*. The female genitalia are very similar to those of *platanella*.

Discussion. — Material has been examined from New York State; a locality not previously cited.

Distribution. — USA: — Ohio, Maryland, New York. Pennsylvania, Kentucky, Florida, Maine. Canada: — Ontario.

Material examined. — ♀ Lectotype: USA: Kentucky, (Chambers); slide no. CNC 3490; in MCZ. Paralectotype: In MCZ — 1 ex., "Peak Acad", "Type no. 14955".

Other specimens: In ANS — USA: Ohio, Cincinnati; on *Platanus* sp.; 2 ♂, 1.viii.1902, 1 ♂, 25.vii.1908, 3 ♀, 8,25,26.vii.1912, 1 ♂, 26.vi.1916, 1 ♀, 27.vi.1916, 1 ♂, 13.vii.1916 (Braun). In USNM — USA: Maryland, Plummers Island; 1 ex., v.1906 (Busch). Florida, Gainesville; on *Platanus occidentalis*; 3 ♂, 7 ♀, 8 ex., 11 + 14.v.1964 (Denmark); 1 ex., 5.viii.1963 (Denmark); 1 ex., 26.viii.1966 (O'Berry); Archbold Biol. Sta., Lake Placid, Highlands Co; 1 ex., 1.v.1975 (Heppner). Maine, Bar Harbour; 1 ♀, 27.v.1936 (Brower). In CNC — New York, Cornell University; 1 ♀, 1 ex., 6.iv.1885 (Murfeldt). Canada: Ontario, St. Williams; continue over on *Platanus occidentalis*; 3 ♂, 2 ♀, 16—26.ii.1960 (Freeman and Lewis). In SOO — Ontario, St. Williams; on *Platanus* sp.; 1 ♂, 20.iii.1962.

Mines examined: In ANS — USA: Ohio, Cincinnati; 2 mines on *Platanus* sp.; 26.vi.1909, B.452 (Braun); 7.ix.1909, B.562 (Braun). In CNC — Canada: Ontario, St. Williams; 19 mines on *Platanus occidentalis*; 3.ix.1959, 59—152, 59—153 (Lewis). In FIS — Ontario, St. Williams; several larvae, pupae and mines preserved in alcohol, 25.viii.1961, 561—7153—01.

Biology. — Mine. An upper surface ophistigmatonome in *Platanus occidentalis* comprising long linear tract terminating in small blotch. The frass line is central in the ophonome but absent in most of the blotch.

Voltinism. Reported as trivoltine (Braun, 1917).

***Ectoedemia similella* (Braun) comb.n.**

(figs. 2, 17, 18, 54, 55, 69)

Nepticula similella Braun, 1917: 188.

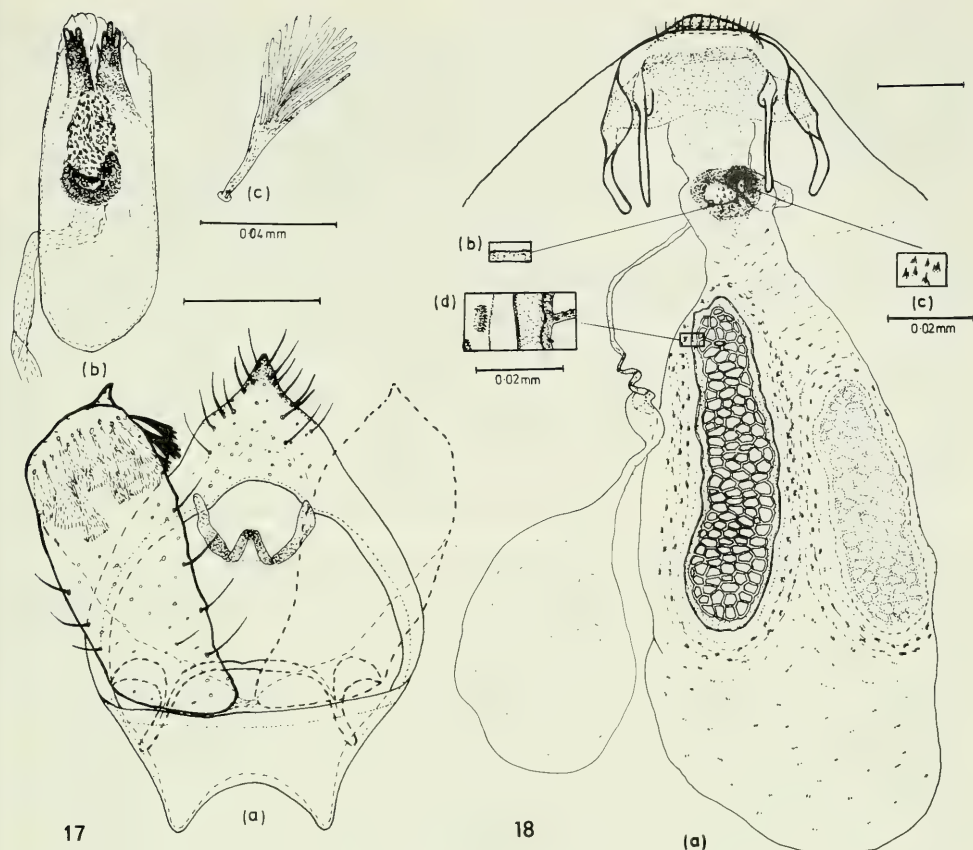
Nepticula similella Braun; Braun in Forbes, 1923: 93.

Nepticula similella Braun; McDunnough, 1939: 107 (no. 9762).

Description. — External features: ♂ ♀. As *platanella* except that: tuft on front of head orange ochreous, vertex paler. Ohio form: Forewings: ground colour of dorsal surface brown with scattered blue and purple reflections, distal half with each scale darker at the tip; single medial fascia, oblique, shining silver and occasionally reduced to marginal streaks. Fig. 54. Florida form: Forewings: ground colour very dark brown to black and uniformly dusted with grey reflections; markings barely visible as marginal patches of not more than five whitish scales; extreme apex of fringe creamy white, giving impression of an apical spot. Fig. 55.¹⁾

Wing expanse: ♂: 4.6—5.6 mm (22 specimens); ♀ 4.2—6.0 mm (16). Holotype: 5.2 mm.

¹⁾ See footnote page 58.



Figs. 17, 18. *Ectoedemia similella* (Braun), ♂ (17) and ♀ (18) genitalia.

Genitalia: ♂ (fig. 17). As *platanella* except that saccus is markedly bilobed, each lobe being as long as broad at base. Valves: rounded distally with small apical style; setae of dorsal surface broad and fan-like as in fig. 17 (c). Aedeagus: markedly shorter than the capsule; anellus comprising a pair of blunted, digitate processes.

Female (fig. 18). As *platanella* except that sclerotised double ring with inner margin weakly serrate, as in fig. 18 (b) and lobe of ductus with small triple spicules as in fig. 18 (c). Bursa copulatrix: signa small in relation to the bursa and unequal in size.

Host plant: *Quercus palustris*, *Quercus rubra*.

Mine: An ophistigmatonome.

Diagnosis. — More often smaller and more iridescent than *platanella* and *clemensella* and differs in the irrorate nature of the forewing ground colour. This species has the lance-shaped chitinous plate on the male hindwing which is absent in *clemensella*. The saccus is more markedly bilobed than in *platanella* and *virgulae* but less than in *clemensella*. The broad, fan-like scales of the valves differ from those of *platanella*, *clemensella* and *virgulae*. The female genitalia resemble those of

the other members of the group in most respects: the unequal size of the signa and the very small spicules of the lobe are the only consistent differences. The mine is easily separated from the lower surface ophionome produced by *Stigmella altella* (Braun) **comb.n.**, which is also found on *Quercus palustris*.

Discussion. — The pattern of wing markings, although resembling that of other members of the species group, is most variable in *similella*. There are two forms: those with a complete fascia which is occasionally reduced to marginal streaks as in *platanellaa* and *clemensella*, which is found in Ohio, New Jersey and Virginia and referred to here as the Ohio form; and those with greatly reduced marginal patches and a diffuse apical patch of off-white ciliae, which is known only from Florida.¹⁾ The Ohio form is that originally described by Braun (*loc.cit*) from ten bred specimens on *Quercus palustris* in Ohio. There is a single female (Specimen 6) from Arkansas, with externals intermediate between the two forms: the forewings are dark chocolate brown with an apical patch of cream, as in the Florida form, and there is a single medial fascia, as in the Ohio form.

Distribution. — USA: — Ohio, New Jersey, Illinois, Virginia, Florida, Arkansas, Kentucky, Maine?

Material examined. — ♂ Holotype: USA: "B.649; Cincinnati, Ohio. Annette F. Braun, i. 21.vi.1914; Type Collection of Annette F. Braun; *Nepticula similella* Braun Holotype"; on *Quercus palustris*; slide no. 109-PJN; in ANS. Paratypes: In ANS — USA: Ohio, Cincinnati; on *Quercus palustris*; 1 ♂, 18.vi.1914, 1 ♂, 22.vi.1914, 1 ♂, 2 ♀, 24.vi.1914, 1 ♀, 27.vi.1914, 1 ♀, 30.vi.1914, 1 ♀, 7.vii.1914, B.649 (Braun). In DFF — Ohio, Cincinnati; on *Quercus palustris*; 1 ♀, 22.vi.1914, B.649 (Braun); slide nos. 107-PJN, 108-PJN, CNC 3479.

Other specimens: In ANS — USA: Ohio, Cincinnati; on *Quercus palustris*; 1 ♂, 2.vi.1922, 2 ♀, 17.vi.1922, 1 ♂, 3 ♀, 21.vi.1922, 1 ♀, 28.vi.1922, B.649 (Braun); on *Quercus rubra*; 1 ♀, 10.vi.1918, B.965 (Braun). In USNM — New Jersey, Anglesea; 1 ♀, "V.30" (Kearfott). Virginia, Mountain Lake; 1 ♂, 24.vii.1940 (Milne and Milne). Illinois, Putnam Co.; 2 ♂, 14.vii.1969, 23.vii.1970 (Glenn). Maine, Millinocket; 1 ex., 11.vii.? Florida, Archbold Bio. Sta., Lake Placid; 1 ♂, 1—7.v.1964, 1 ♂, 2 ♀, 8—15.v.1964, 3 ♂, 16—22.v.1964 (Hodges). Oneco, Manatee Co.; 8 ♂, 5—14.v.1953, 3.ix.1953, 2.xi.1953 and 17.xi.1954 (Dillman). Gulf Coast Exp. Sta., Bradenton; 1 ♂, 24.iii.1955 (Keisheimer).

Specimen 6: In USNM — USA: Arkansas, Devil's Den St. Pk., Washington County; 1 ♀, 24.vi.1966 (Hodges); *al. ex.* 5.6 mm; slide no USNM 17256.

Mines examined: In ANS — USA: Ohio, Cincinnati; 2 mines on *Quercus palustris*; 30.viii.1911, B.649 (Braun); 3 mines on *Quercus rubra*; 21.x.1917, 8.965 (Braun).

Biology. — Egg. Laid on the upper surface.

Host. Braun (1917 and breeding records) reports that similar mines have been

¹⁾ Footnote Post Scriptum: Since the description of this species was written, more material has become available from Florida. Some of these specimens have complete fasciae, whilst retaining other characters of the dark form. It still remains that Florida is the only state recording the form with incomplete fasciae, but it now seems unlikely that the variation is geographically based as was first thought probable (CW).

found on chestnut in Kentucky although the material in question cannot be located.

Mine. The early part of the mine is very narrow and much contorted in close S-shaped curves, with the frass scattered throughout its breadth. The larva then forms a lower surface blotch in which the frass is deposited as a congealed mass at the beginning (fig. 69).

Larva. Pale green in colour, emerging on the lower surface in most cases.

Pupa. Cocoon ochreous in colour.

Voltinism. Adults have been taken in May, throughout June and early July, while late instar larvae are found from July to October. It is possible that there are up to three broods per year.

***Ectoedemia virgulae* (Braun) comb.n.**
(figs. 19, 20, 56, 57, 70)

Nepticula virgulae Braun, 1927: 198.

Nepticula virgulae Braun; McDunnough, 1939: 107 (no: 9751).

Description. — External features: ♂ ♀. As *platanella* except that tuft on front of head orange-ochre, vertex paler. Thorax and abdomen dark brown with bronze reflections. Forewings: ground colour of dorsal surface brown to very dark chocolate brown with bronze and purple reflections, distally each scale darker at the tip; single medial fascia, variable in breadth, oblique, shining silver and markedly concave inwardly. Figs. 56 (♀ Ohio) and 57 (♂ Florida).

Wing expanse: ♂: 3.8—5.0 mm (12 specimens); ♀: 4.0—5.8 mm (19). Holotype: 4.0 mm.

Genitalia: ♂ (fig. 19). As *platanella* except that valves markedly concave along inner margin distally; setae of dorsal surface terminally digitate, with long basal shaft as in fig. 19 (c). Aedeagus: markedly shorter than the capsule; anellus comprising a pair of bifurcate plates as in fig. 19 (b).

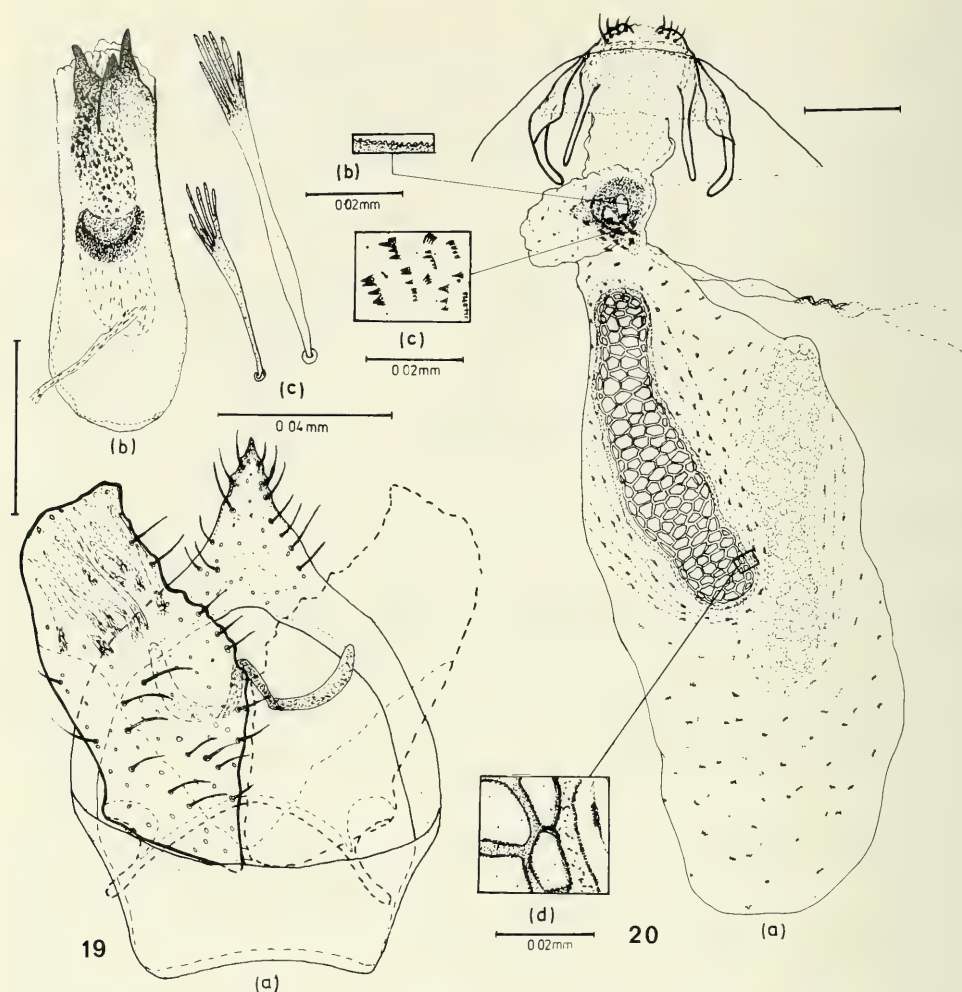
Female (fig. 20). As *platanella* except that sclerotised double ring with inner margin markedly serrate, as in fig. 20 (b), and lobe of ductus with large triple spines as in fig. 20 (c). Bursa copulatrix: signa small in relation to the bursa.

Variation. In externals, the ground colour of the forewings varies in intensity from the pale form in Ohio to dark chocolate brown in Florida and Texas. The breadth of the fascia varies and is broadest in those specimens examined from Florida. Similarly, there is a greater degree of variation in the male genitalia than is found in other members of the species group. The pseuduncus ranges in length and shape from the short, blunted form in Florida to a longer more tapering form in Ohio and Texas (fig. 19). The setae of the valves are more heavily sclerotised and longer in Florida males than in those from Ohio and Texas illustrated in fig. 19 (c).

Host plant: *Corylus americana*.

Mine: An upper surface ophionome.

Diagnosis. — More often smaller than *platanella* or *clemensella* and differs in the irrorations and reflections of the forewings; as far as observed the fascia is always complete in *virgulae*. The saccus is more weakly bilobed and the valves more



Figs. 19, 20. *Ectoedemia virgulae* (Braun), ♂ (19) and ♀ (20) genitalia.

concave along the inner margin than in *similella* or *clemensella*. The setae of the valves differ from those of *platanella*, *clemensella* and *similella* in the longer shaft and the longer terminal ciliae. The female genitalia resemble those of the other members of the group; the large, triple spines of the accessory lobe and the smaller signa separate them from *platanella*. The mine is broader than that of *Stigmella corylifoliella* (Clemens), but narrower than *Stigmella ostryaefoliella* (Clemens), both of which are also found on *Corylus* sp.

Discussion. — Originally described from four bred specimens on Hazel (*Corylus americana*). The variation in externals of the material examined here shows a similar geographical distribution to that in *similella*: a darker form being recorded in the southern states (Florida and Texas). In *virgulae*, however, this also corresponds with a difference in the male genitalia of the Florida specimens. In the two males from Texas the transtilla are much stouter than in the type; this may be due

to distortion but is possibly a geographical or seasonal difference (these adults were on the wing in September).

Distribution. — USA:— Ohio, Texas, Florida.

Material examined. — ♂ Holotype: USA: "B.1107, Clinton County, Ohio, 24.iv.1925; Type; *Nepticula virgulae* Braun type"; on *Corylus americana*; slide no. 100-PJN; in ANS. ♀ Allotype: same data as Holotype; i.15.v.1925; slide no. 102-PJN; in ANS. Paratypes: In ANS—USA: same data as Holotype; Ohio, Clermont County; 1 ♂, 1 ♀, vii.1924; slide nos. 101-PJN, 103-PJN.

Other specimens: In USNM—USA: Texas, Bexar County; 2 ♂, 3 ♀, 11.ix.1959 (McGregor). Florida, Lake Placid, Archbold Bio. Sta.; 6 ♂, 5 ♀, 8—15.v.1964, 3 ♂, 7 ♀, 16—22.v.1964 (Hodges). Florida, Fisheating Creek, Palmdale; 2 ♀, 7—10.v.1964 (Hodges).

Biology. — Mine. A gradually broadening linear mine with the frass scattered in a broad tract (fig. 70).

Larva. Green in colour.

Pupa. Cocoon reddish brown in colour.

Voltinism. Possibly bivoltine in Ohio, with adults emerging in April, May and July; Braun's breeding records show that late instar larvae are present in August and September. Adults have also been taken in May from Florida and in September from Texas.

THE RUBIFOLIELLA GROUP

This group has three species, *rubifoliella*, *ulmella* and *quadrinotata* with the pseuduncus prolonged backwards but bluntly rounded; the aedeagi have moderately large, similar, anellar projections in males, and females are without thickened or sclerotised collicula. The species *nyssaefoliella* is assigned here on the grounds that the female is typical, having no colliculum. It has unusually broad and enlarged anterior apophyses. The male however is more typical of the *populella* group with the pointed pseuduncus. However the aedeagus (like specimen 8) is devoid of any large spines or anellar projections. Another species which does not conveniently fit into a species-group is *lindquisti* which in the male looks like *quadrinotata* but with smaller anellar spines and more pointed pseuduncus. It also has similarities with the preceding groups as indicated in the species diagnosis. The female has the sclerotised ring-shaped colliculum reminiscent of *populella*.

Ectoedemia lindquisti (Freeman) (figs. 21, 22, 43)

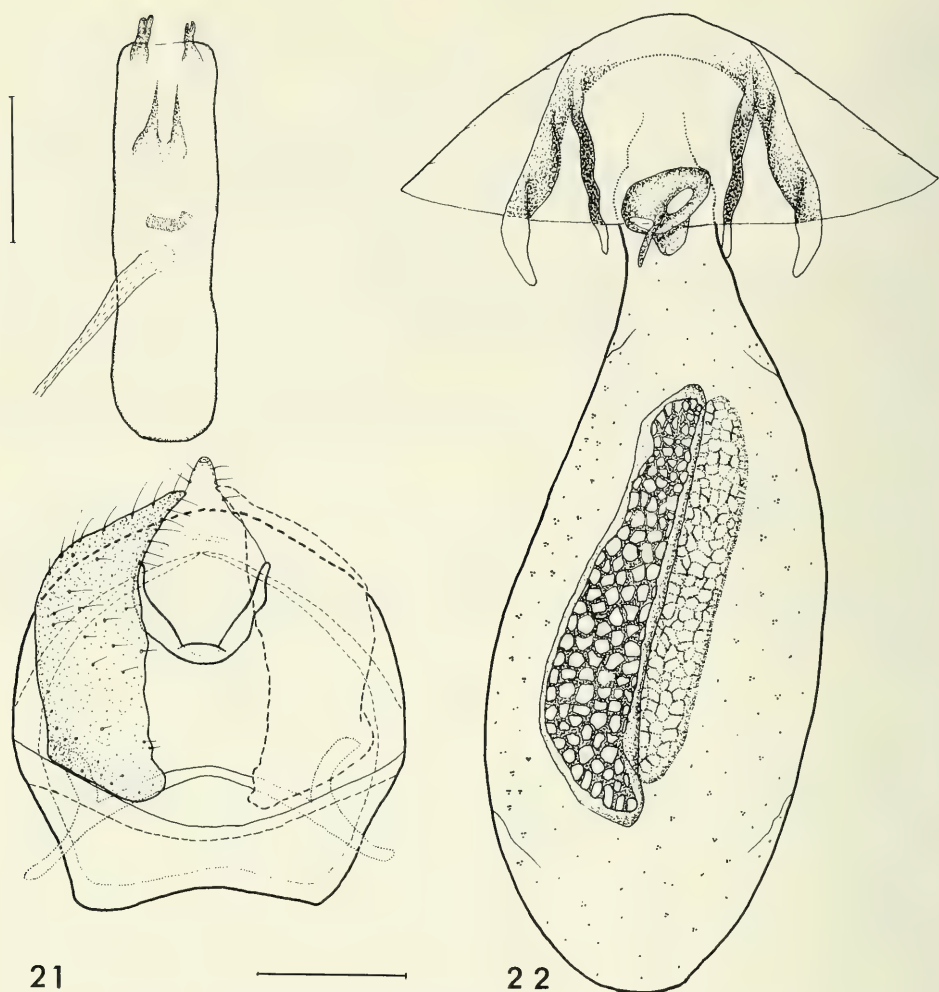
Nepticula lindquisti Freeman, 1962: 522.

Nepticula lindquisti Freeman; Lindquist, 1962: 524.

Ectoedemia lindquisti (Freeman); Wilkinson & Scoble 1979: 83.

Description. — Fully described from Canada by Wilkinson & Scoble (1979).

Diagnosis. — The darker tufts on the head and the generally darker ground colour separate *lindquisti* from the members of the *platanella* group. Differs from *marmaropa* in the absence of the basal patch of the forewings. The genitalia re-



Figs. 21, 22. *Ectoedemia lindquisti* (Freeman), ♂ (21) and ♀ (22) genitalia.

semble those of the *platanella* group but differ in the absence of the setae of the valves, in males, and the lobe of the colliculum, in females. The digitate processes of the aedeagus are less complex than those in *similella* and *marmaropa* (compare fig. 21 with figs. 17 and 11).

Discussion. — Additional specimens to those cited by Wilkinson & Scoble (1979), from Maine indicate that the species has a wider distribution than has been previously cited. One male has darker head tufts than is usual for the species, but is otherwise indistinguishable. See also discussion for *canadensis*, p.

Distribution. — USA:— Maine. Canada:— Ontario.

Material examined. — ♂ Holotype: Canada. Ontario, Lake Huron, Wiarton; on *Betula papyrifera*; 13.vi.1959, 559.0049.01; Type no.: 7752; in CNC. Paratypes: In CNC—Canada: data as Holotype; 26 ♂, 12 ♀, 8.vi.—1.viii.1959.

Other specimens: In ANS—USA: Maine, Bethel; 2 ♂, 1 ♀, 29.vi.1946 (Braun).

Canada: data as Holotype; 1 ♀, 8.vi.1959. In SOO—Ontario, Trout Creek; on *Betula alleghaniensis*; 1 ♀, 24.iii.1958.

Biology. — A thorough study has been made by Lindquist (1962) for whom the species was named by Freeman.

Egg. Laid on underside of *Betula* leaves (*B. papyrifera*, *B. alleghaniensis* = *lutea*), sometimes in large numbers on one leaf.

Mine. Is an upper surface stigmatonome with a more or less rectangular blotch between two leaf veins. Frass is deposited in circular patches.

Larva. Whitish in colour with translucent integument and pale yellow head.

Cocoon. Yellow-brown darkening with time and deposited in soil and litter. Larva overwinters in cocoon.

Voltinism. Univoltine.

***Ectoedemia rubifoliella* (Clemens)**

(figs. 23, 24, 49)

Nepticula rubifoliella Clemens, 1860: 214.

Nepticula rubifoliella Clemens; Clemens, 1865: 146.

Nepticula rubifoliella Clemens; Clemens in Stainton, 1872: 32, 42, 45, 152.

Nepticula rubifoliella Clemens; Chambers in Hayden, 1878b: 158.

Nepticula rubifoliella Clemens; Dyar, 1903: 547.

Nepticula rubifoliella Clemens; Busck, 1903: 208.

Nepticula rubifoliella Clemens; Braun, 1917: 183.

Nepticula rubifoliella Clemens; Braun in Forbes, 1923: 91.

Nepticula rubifoliella Clemens; McDunnough, 1939: 107 (no: 9750).

Ectoedemia rubifoliella (Clemens); Wilkinson & Scoble, 1979: 90.

Description. — Fully described from Canada by Wilkinson & Scoble (1979).

Diagnosis. — Resembles *virgulæ* in externals, although *rubifoliella* is generally darker and the fascia broader. The males lack the chitinous plate of the hindwings found in *virgulæ*. The nature of the pseuduncus and the relatively short aedeagus separates the male genitalia from those of *ulmella* and *quadrinotata*, whilst the females differ only in the relative sizes of the signa.

Distribution. — USA:— Ohio, Kentucky, Pennsylvania (Clemens). Canada:— Ontario, Quebec.

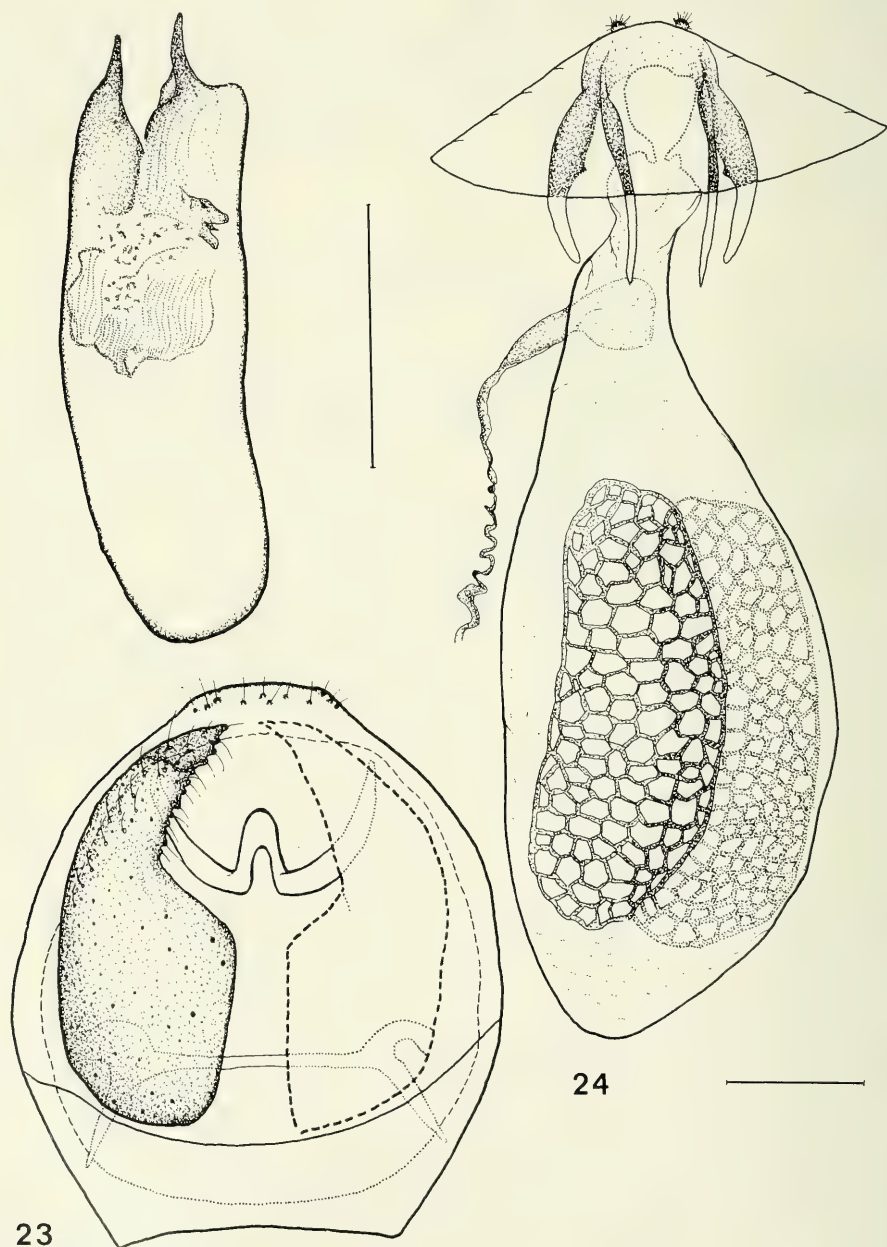
Material examined. — ♂ Neotype: USA: Ohio, Cincinnati; on *Rubus* sp.; 23.v.1916 (Braun); slide no: USNM 17339; in ANS.

Other specimens: In USNM — USA: data as neotype; 2 ♀, 18.viii.1912, 1.vi.1916 (Braun). Kentucky, Red Bird River; 1 ♂, 19.viii.1933 (Braun). In CNC — Canada: Ontario, Simcoe; on *Rubus* sp.; 1 ♂, 14.ii.1966 (Freeman). Quebec, Hull; on *Rubus* sp.; 2 ♀, 21.iii.1959 (Freeman and Lewis); 1 ex., 31.iii.1957 (Freeman). Mines examined: In ANS — USA: Ohio, West Fork Woods; 1 mine on *Rubus* sp.; 6.ix.1909, B.558 (Braun); 1 mine on *Rubus* sp.; 4.vii.1909, B.558 (Braun). In CNC — Canada: Ontario, Simcoe; 5 mines on *Rubus* sp.; 1965, 65—74 (Freeman). Quebec, Hull; 3 mines on *Rubus* sp.; 1965, 56—257 (Freeman and Lewis).

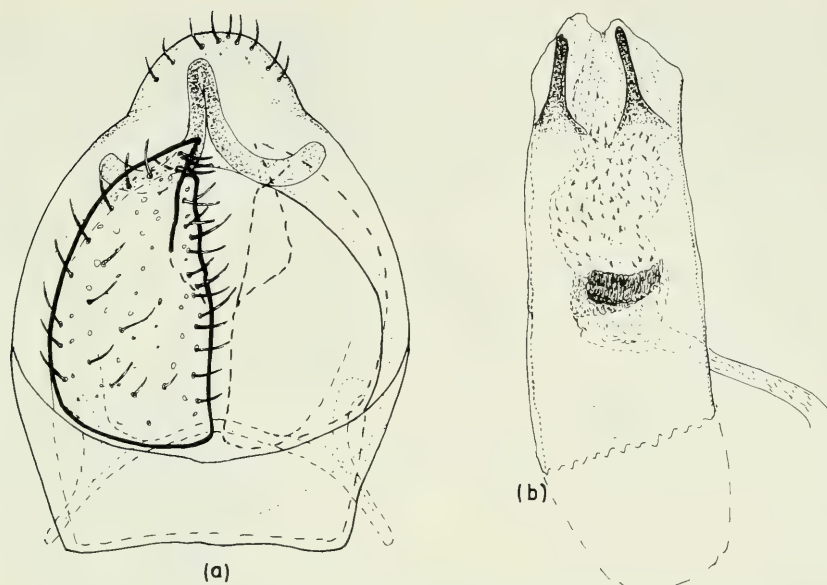
There is a single male with externals and genitalia similar to *rubifoliella* except that the ground colour is paler and the pseuduncus, valves and gnathos differ as in fig. 25. According to the label data this specimen was reared from *Quercus plata-*

noides (the same series of mines from which Braun reared examples of *Stigmella flavipedella* (Braun)). If this is correct then the mine differs from that of *rubifoliella* in that it is a much contorted linear tract.

Specimen 7: In ANS — USA: Ohio, Cincinnati; on *Quercus platanoides*; 1 ♂, 30.v.1922, B.653 (Braun); *al.ex.* 4.4 mm.; slide no: 130-PJN.



Figs. 23, 24. *Ectoedemia rubifoliella* (Clemens), ♂ (23) and ♀ (24) genitalia.



25

Fig. 25. *Ectoedemia*, specimen 7, ♂ genitalia.

Biology. — Mine. A linear tract is made in *Rubus* (Blackberry) leaves and the frass-line is broken and central. It then widens into a rather elongate blotch forming an upper surface ophistigmatonome with the frass irregularly dispersed.

Pupa. Cocoon is dark brown.

Voltinism. Braun (1917) reports 2 generations.

***Ectoedemia ulmella* (Braun)**

(figs. 26, 27)

Nepticula ulmella Braun, 1912: 87.

Nepticula ulmella Braun; Braun, 1917: 186.

Nepticula ulmella Braun; Braun in Forbes, 1923: 92.

Nepticula ulmella Braun; McDunnough, 1939: 107 (no: 9758).

Ectoedemia ulmella (Braun); Wilkinson & Scoble, 1979: 91.

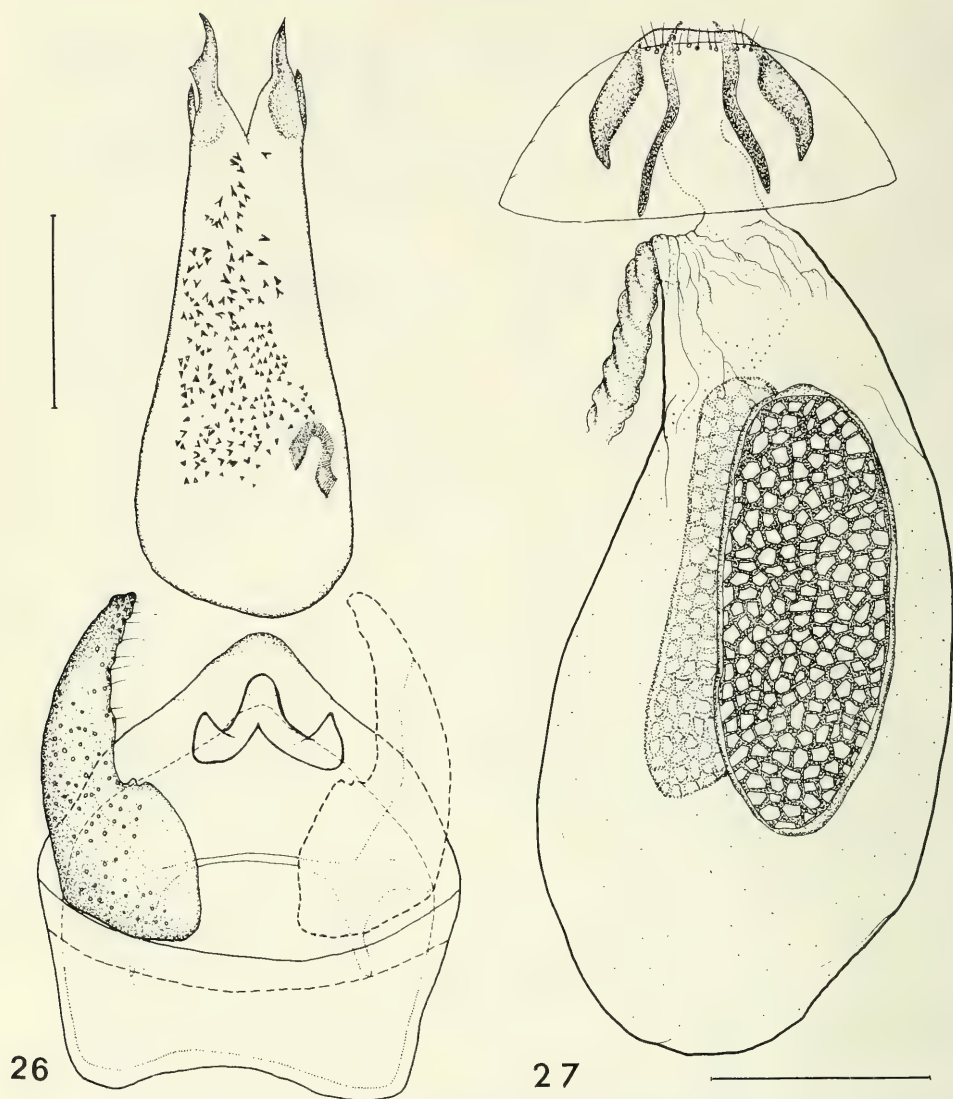
Description. — Fully described from Canada by Wilkinson & Scoble (1979).

Diagnosis. — Larger and less iridescent than *rubifoliella*. The tapering valves and the broad gnathos separate the males from those of *rubifoliella*, while the only consistent difference in the females is the smaller and more ovate signa retinacula of *ulmella*.

Discussion. — We have examined an additional male from New York which indicates that the species has a wider distribution than has been previously cited.

Distribution. — USA:— Ohio, Pennsylvania, New York, Kentucky. Canada:— Ontario, Quebec.

Material examined. — ♂. Lectotype: USA: Ohio, Cincinnati; on *Ulmus* sp.;



Figs. 26, 27. *Ectoedemia ulmella* (Braun), ♂ (26) and ♀ (27) genitalia.

18.viii.1912, B. 578 (Braun); slide no: USNM 16251; in ANS. Paralectotype: In ANS — USA: Ohio, Clermont Co., on *Ulmus* sp.; 1 ♀, 10.viii.1912 (Braun).

Other specimens: In ANS - USA: Ohio, Cincinnati; Overbook; on *Ulmus americana*; 1 ex., 27.vii.1955 (Lewis); on *Ulmus* sp.; 1 ♀, no date (Braun), 1 ♂, 24.vi.1905, 1 ♀, 8.vi.1912, 1 ♂, 1 ♀, 3.vii.1907, 1 ex., 6.ix.1954 (Braun). In USNM - Pennsylvania, Pittsburgh; 1 ♂, 23.vii.1906 (Engel). New York, Cornell University, Ithaca; on *Ulmus* sp.; 1 ♂, no date (Murfeldt). In CNC — Canada: Quebec, Kingsmere; on *Ulmus fulva*¹); 2 ♂, 3 ♀, 2 ex., 12—30.vii.1956 (Lewis). Ontario, La Passe; on *Ulmus americana*; 1 ♀, 25.ii.1971, 1 ♂, 22.ii.1971, 1 ♂, 26.iii.1971 (Lewis).

Mines examined: In ANS — USA: Ohio, Anderson's Ferry; 1 mine on *Ulmus fulva*¹); 20.ix.1909, B.578 (Braun); 1 mine on *Ulmus racemosa*; 21.vii.1913, B.578 (Braun). In CNC — Canada: Ontario, Kingsmere; 2 mines on *Ulmus rubra*; 11.ix.1955, 55—281 (Lewis). Ontario, La Passe; 1 mine on *Ulmus americana*; 16.ix.1970, 70—111A (Rockburne and Lewis). Ontario, Ottawa; 5 mines on *Ulmus americana*; 7.viii.1955, 55—137A (Lewis). Quebec, Kingsmere; 3 mines on *Ulmus rubra*; 10.ix.1955, 55—279 (Lewis); 2 mines on *Ulmus fulva*¹); 10.ix.1955, 55—279 (Lewis).

Biology. — Mine. Is a much contorted frass filled tract in leaves of several species of *Ulmus* including *U. rubra* (Slippery or Red Elm), *U. americana* (White Elm) and *U. thomasi*¹) (Rock or Cork Elm). The tract expands into a blotch so producing an upper surface ophistigmatonome. The frass is deposited in both patches and lines.

Cocoon. Reddish brown and usually spun within the mine-blotch.

Voltinism. Bivoltine with mature larvae present in July and September (Braun, 1917).

***Ectoedemia nyssaefoliella* (Chambers) comb.n.**
(figs. 28, 29, 58, 59, 71)

Nepticula nyssaefoliella Chambers, 1880: 66.

Nepticula nyssaefoliella Chambers; Dyar, 1903: 546.

Nepticula nyssaefoliella Chambers; Braun, 1909: 429.

Nepticula nyssaefoliella Chambers; Braun, 1917: 183.

Nepticula nyssaefoliella Chambers; Braun in Forbes, 1923: 91.

Nepticula nyssaefoliella Chambers; McDunnough, 1939: 107 (no: 9752).

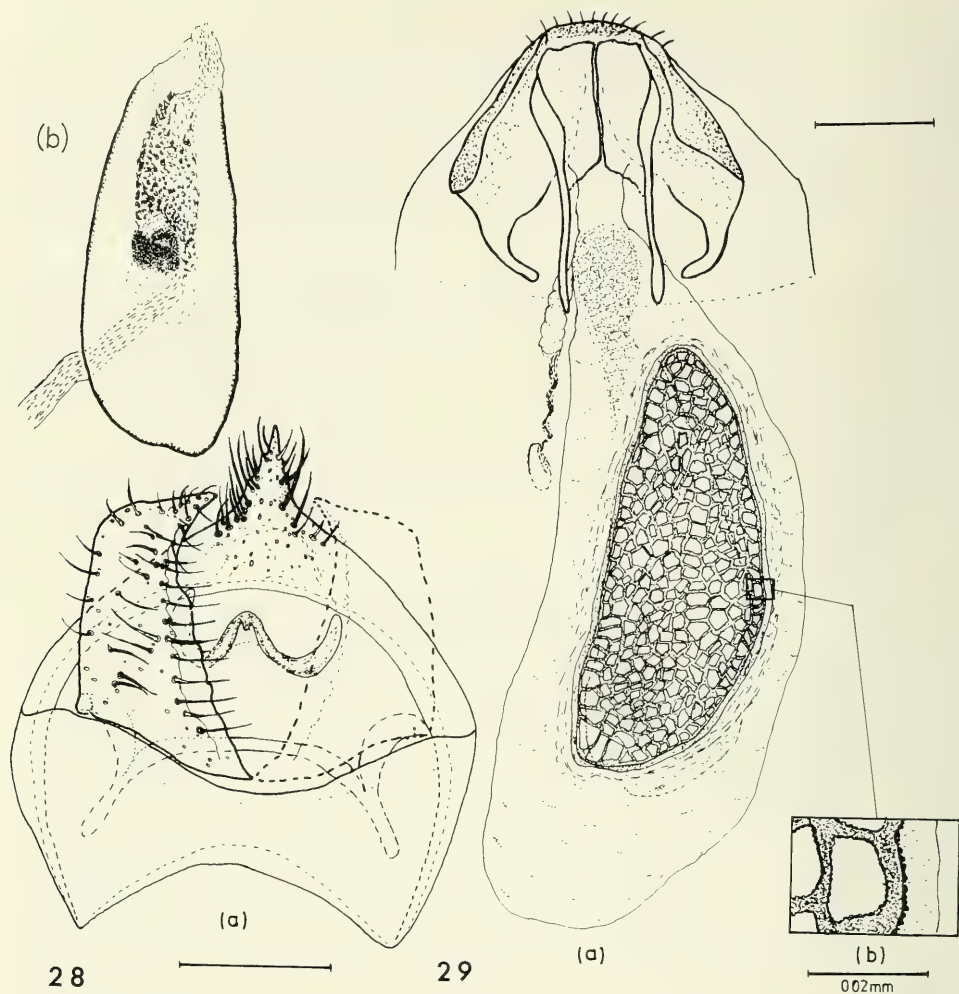
Description. — External features: ♂. Head: Palps greyish; antennae dark brown; tuft on front of head ochreous, vertex orange-ochreous; eye-caps shining white; collar pale ochre. Thorax and abdomen dark brown, thorax with purple reflections, abdomen with silver reflections above, shining metallic grey beneath. Forewings: ground colour of dorsal surface dark brown with bronze reflections which become stronger towards the apex, distal scales darker at the tips; fringe greyish brown, shining silver, with an apical band of dark brown wing-scales; single medial fascia, shining silver, biconcave. Hindwings: ground colour and fringe brownish grey; an oval patch of creamy white scales extending from base to middle of dorsal surface, sometimes absent. Legs dark brown, shining silver behind. Fig. 58.

Female. As ♂ except for hindwings without specialised scales. A pair of convex external pockets on ventral side of the fourth abdominal segment, medial in position (fig. 59).

Wing expanse: ♂: 4.2—6.4 mm (14 specimens); ♀: 4.6—6.4 mm (14). Neotype: 5.0 mm.

Genitalia: ♂ (fig. 28). Pseuduncus with a single tapering lobe. Gnathos: W-shaped as in fig. 28 (a); transverse ventral plate with broad central boss. Vinculum:

¹) N.B. *Ulmus rubra* Muhl. = *U. fulva* Michx. *Ulmus racemosa* Thomas = *U. thomasi* Sarg.



Figs. 28, 29. *Ectoedemia nyssaefoliella* (Chambers), ♂ (28) and ♀ (29) genitalia.

lateral arms broad, ventral plate narrow. Saccus more than two-times the width of the ventral plate, bilobed. Valves not reaching beyond the pseuduncus, quadrate with a triangular style arising distally. Transtillae: lateral arms narrow; ventral arms long and narrow, reaching well beyond the ventral plate; transverse arms fused. Aedeagus: regular in width, approximately equal to length of the capsule; vesica with cornuti as many small denticles and with a cup-shaped plate of minute papillae.

Female (fig. 29). Ductus bursae short and narrow with spiral duct arising medially. Bursa copulatrix: large and covered with scallop-shaped chains of pectinations on striations of the bursa; signum double, comprising a pair of unequal cellular patches, one ovate and one constricted proximally, as in figs. 29 (a) and (b). Anterior apophyses very broad basally, tapering markedly. Posterior apophyses straight and narrow, reaching beyond the anteriores.

Host plant: *Nyssa sylvatica* (Sour Gum).

Mine: An upper surface ophistigmatonome.

Diagnosis. — Generally darker and the fascia narrower than in *platanella* or members of the *platanella* group. The male genitalia are easily differentiated from those of any other member of the genus, listed on page 37, by the absence of the anellar processes. The females resemble those of *rubifoliella*, *ulmella* and *quadri-notata* in the absence of a strongly sclerotised colliculum but may be separated by the unequal signa, one of which is constricted proximally, in *nyssaefoliella*.

Discussion. — This species was originally described by Chambers (1880) from the mine; adults reared from *Nyssa* sp. were described by Braun (1909) and given the same name. Although the mine(s) constitute the original type material, they were never preserved or designated. Braun (1909) does not mention the specialised scale patch present in some specimens in her first description of the imago, but does so in a later publication (1917). All the male specimens dated 1909 or earlier and presumably described by Braun (1909), possess the specialised scale patch, those collected at later dates and presumably described by Braun (1917) do not show evidence of specialised scale patches. We designate as Neotype one of the males examined by Braun in 1909, which possesses specialised scale patches.

It is not unlikely that these two forms of male represent separate species; but in the absence of any further evidence we treat them as one. Several examples of the loss of such specialized scales later in life are known within the Lepidoptera, although this is the first possible example in the Nepticulidae.

There are two females reared from *Amelanchier* sp. by C. Heinrich with indistinguishable genitalia from those of *nyssaefoliella*. The externals of two females differ from the type of *nyssaefoliella* (which is similar to the others) in the more irrorate nature of the forewings and the broader fascia. The differences may result from the different host plant but may indicate a separate species. "*Nepticula amelanchierella*" Clemens, 1861, was described and is still only known from the mine.

Distribution. — USA:— Ohio, Virginia, New Jersey, Kentucky.

Material examined. — Designated as neotype: 1 ♂ from the series examined by Braun 1909: USA: "B. 454, Cincinnati, Ohio. Annette F. Braun, 31.vii.1909: *Nepticula nyssaefoliella* Cham." — on *Nyssa sylvatica*; slide no: 138-PJN; in ANS.

Other specimens: In ANS — USA: Ohio, Cincinnati; 3 ♂, 4 ♀, 20.vi.1911 (Braun); on *Nyssa sylvatica*; 1 ♀, 25.vii.1909, 3 ♂, 3, 16, 17.viii.1909, 2 ♂, 1 ♀, 27.vi.1911, 1 ♀, 22.vi.1914, B.454 (Braun). In USNM — Ohio, Cincinnati; 1 ♀, 26.vi.1907 (Braun); on *Nyssa sylvatica*; 1 ♀, 27.vi.1911, B.454 (Braun); 1 ♂, 15.vi.1911; 4 ♂, 2 ♀, 20.vi.1911, 1 ♀, 26.vi.1916 (Braun). New Jersey, Anglesea; 1 ♀, v, 30 (Kearfott). In FIS — Virginia, Mountain Kale; "WH 3"; 2 ♂, 21.vii.1940 (Milne and Milne).

Tentative identifications: In USNM — USA: Virginia, Falls Church; "11153 Hopk. US"; on *Amelanchier* sp.; 1 ♀, 3.vii.1913 (Reared C. Heinrich). In DFF — 1 ♀, same data.

Mines examined: In ANS — USA: Ohio, Ferris Woods; 1 mine on *Nyssa sylvatica*; 28.vi.1909, B.454 (Braun).

Biology. — Egg. Laid on the lower surface and, in the single case observed, next to the midrib of the *Nyssa* leaf.

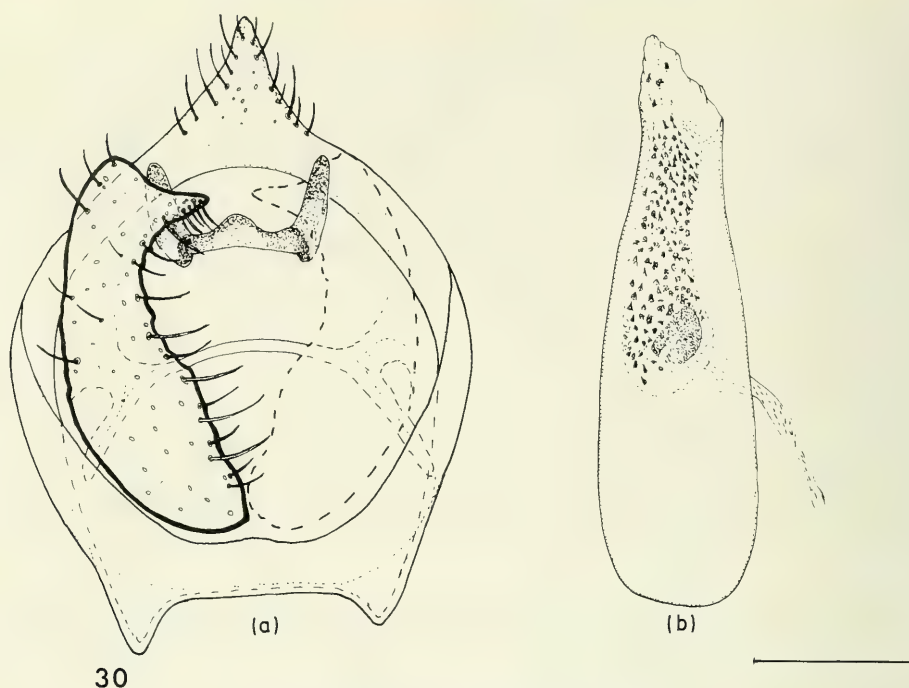


Fig. 30. *Ectoedemia*, specimen 8, ♂ genitalia.

Mine. Begins as a very narrow linear tract which abruptly broadens into an elongate blotch on the upper surface. The frass is deposited as a continuous black line in the centre of the linear portion and in a much contorted tract throughout the blotch (fig. 71).

Larva. Emerges on the upper surface of the leaf.

Pupa. Pale green in colour.

Voltinism. Two or possibly three generations per year.

There is a single male with externals as *nyssaefoliella* except that the ground colour of the forewings is darker and the *al. ex.* greater by almost 1 mm. The genitalia of this specimen resemble those of *nyssaefoliella* in overall form but differ in the gnathos, which is more typical of *Stigmella* rather than *Ectoedemia*, and the relatively larger aedeagus, see figs. 30, 60.

Specimen 8: In ANS — USA: Ohio, Cincinnati; 1 ♂, 20.vi.1911 (Braun); *al. ex.* 7.0 mm.; slide no: 135-PJN.

***Ectoedemia quadrinotata* (Braun)**
(figs. 31, 32, 48)

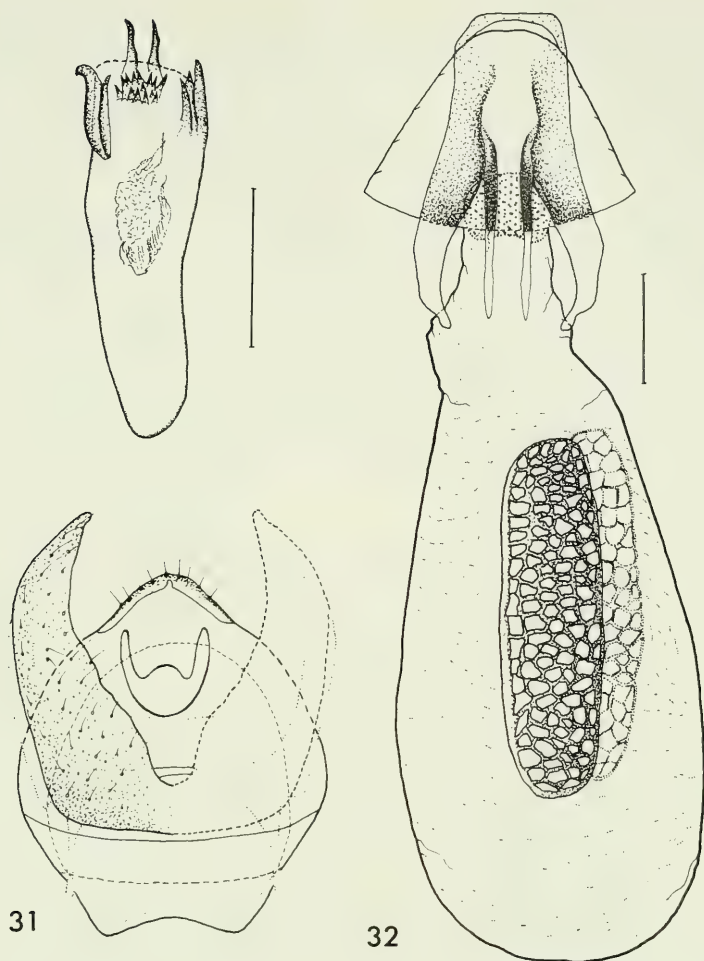
Nepticula quadrinotata Braun, 1917: 168.

Nepticula quadrinotata Braun; Braun in Forbes, 1923: 86.

Nepticula quadrinotata Braun; McDunnough, 1939: 107 (no: 9722).

Ectoedemia quadrinotata (Braun); Wilkinson & Scoble, 1979: 95.

Description. — Fully described from Canada by Wilkinson and Scoble (1979).



Figs. 31, 32. *Ectoedemia quadrinotata* (Braun), ♂ (31) and ♀ (32) genitalia.

Diagnosis. — The externals resemble those of *trinotata* except that there are two antemedial spots in *quadrinotata*. The tuberculate pseuduncus and the elaborate anellar processes differentiate the male from other members of *Ectoedemia* studied here. The female genitalia resemble those of *rubifoliella*, *ulmella* and *nysaefoliella* but differ in the presence of a weakly sclerotised colliculum in *quadrinotata*.

Discussion. — A specimen found in USNM collection taken in Arkansas, indicates that the species has a wider distribution than has been recorded previously.

Distribution. — USA:— Ohio, Arkansas, Kentucky. Canada:— Ontario.

Material examined. — ♀. Holotype: USA: Ohio, Cincinnati; on *Carpinus* sp.; 28.v.1914, B.538 (Braun); slide no: USNM 17326; in ANS. Paratypes: In ANS — USA: data as Holotype; 2 ♂, 1 ♀, 27—30.v.1914 (Braun); Sugar Grove; on *Corylus* sp.; 1 ♂, 1 ♀, 1.vi.1915 (Braun).

Other specimens: In USNM — USA: Ohio, Cincinnati; on *Carpinus* sp.; 1 ♂,

30.v.1914, 1 ♀, 31.v.1917, 2 ♂, 1 ♀, 2, 9.vi.1917, 1 ex., 26.v.1919, (Braun). Arkansas, Washington Co.; 1 ♀, 11.v.1966 (Hodges). Ontario, Sparrow lake; 8 ♂, 1 ♀, 12.vii.1926 (Braun). Ontario, Severn; on Ironwood; 2 ♂, 1 ♀, 16—20.vi.1925 (McDunnough). In SOO — Ontario, Trout Creek; on *Betula alleghaniensis* 1 ♀, 19.iii.1958, 1 ♀, 3.iv.1958.

Mines examined: In ANS — USA: Ohio, Still House Hollow; 2 mines on *Carpinus* sp. 24.viii.1909, B.538 (Braun).

Biology. — Mine. The mine begins as an ophionome — a narrow linear tract extending along the mid-rib or between two leaf veins and broadens, so filling the space between them. Later the mine widens further and becomes virtually a blotch. The frass is dark initially forming a broken line which becomes less compact and later diffuse. The mine is principally the same regardless which of the four host plants is attacked: *Carpinus caroliniana* (Hornbeam), *Corylus americana* (Hazel), *Ostrya virginiana* (Ironwood), *Betula alleghaniensis* (now: *B. lutea*) (Yellow Birch).

Voltinism. Bivoltine.

THE CASTANEA GROUP

The following eight taxa resemble each other particularly in the genitalia. Of special note are the following: very round pseuduncus, form of valves, complex cornuti and anellar processes in males; the thickened colliculum which lacks the characteristic sclerotised ring of other groups, very long posterior apophyses, especially in comparison with anterior ones, and the long narrow genitalia in females. Together with these features the similar venation with expanded costal margin of hind wing (fig. 1) and similar wing markings show this to be a discrete group. To this add the fact that all attack bark, as far as is known, but some form galls and others mine.

In many ways this group presumably corresponds with the sub-genus *Zimmermannia* Hering, 1940, adopted by several European workers. However the name is not used here because the diagnosis which separates the gall makers from the bark miners is invalid.

The group is called the *castaneae* group rather than by the older name *obrutella* because of the uncertainty about the latter life history and site of larval attack.

Ectoedemia obrutella (Zeller)

(figs. 1, 33, 34, 47)

Trifurcula obrutella Zeller, 1873: 316.

Trifurcula obrutella Zeller; Dyar, 1903: 547.

Ectoedemia obrutella (Zeller); Busck, 1913: 103.

Ectoedemia obrutella (Zeller); Braun, 1917: 200.

Ectoedemia obrutella (Zeller); Braun in Forbes, 1923: 83.

Ectoedemia obrutella (Zeller); McDunnough, 1939: 107 (no: 9782).

Nepticula bosqueella Chambers in Hayden, 1878a: 106 (syn. by Busck, 1903: 208).

Nepticula bosqueella (sic) Chambers; Chambers in Hayden, 1878b: 157.

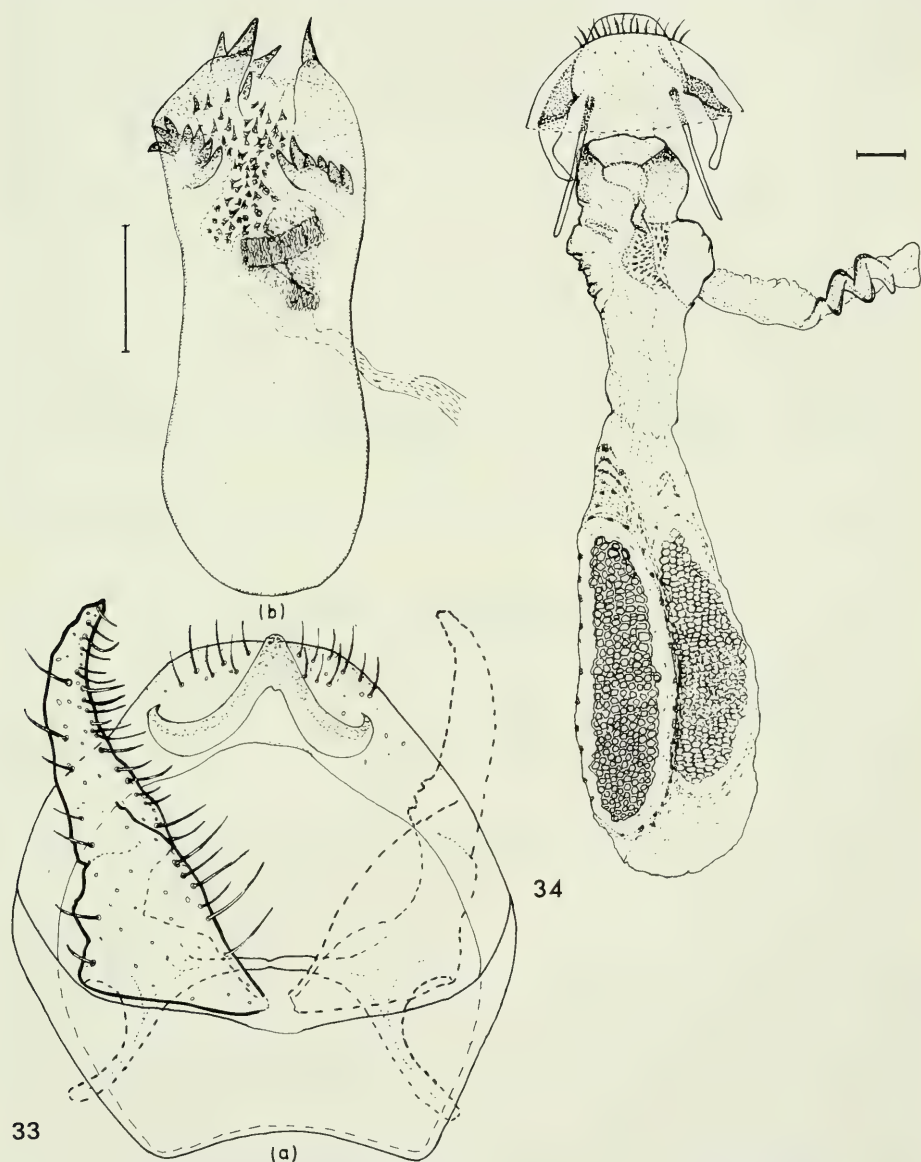
Opostega bosqueella (sic) Chambers; Dyar, 1903: 547 (mistaken genus).

Nepticula bosquella Chambers; Busck, 1903: 208 (cited under *Opostega albogaleriella*).

Ectoedemia bosqueella (sic) (Chambers); Braun, 1917: 200.

Ectoedemia bosquella (Chambers); Meyrick, 1928b: 426.

Description. — External features: ♂, ♀. Head: palps off-white; antennae sandy buff; tufts on front of head and vertex chocolate-brown; eye-caps creamy white; collar chocolate-brown. Thorax creamy white with scattered brown scales above. Abdomen greyish, shining metallic grey beneath. Forewings: ground colour of dorsal surface creamy white, weakly lustrous, irrorate with brown scales partic-



Figs. 33, 34. *Ectoedemia obrutella* (Zeller) Busck, ♂ (33) and ♀ (34) genitalia.

ularly dense basally and terminally giving the impression of a medial, pale fascia; fringe whitish, weakly lustrous. Hindwings: ground colour and fringe shining white; with a pale yellow brush of ciliae at the base of the costa; costa emarginated. Legs: buff with scattered yellow-gold reflections, darker behind; hind tibiae densely covered inwardly with sharp bristles. Fig. 47.

Wing expanse: ♂: 7.4—9.5 mm (44 specimens); ♀: 7.6—10.0 mm (27).

Genitalia: ♂ (fig. 33). Pseuduncus with a single lobe, broad and flattened. Gnathos: an inverted V as in fig. 33 (a); transverse ventral plate with a large medial process; dorso-lateral arms very broad and weakly arcuate. Vinculum: lateral arms broad, ventral plate broad. Saccus approximately half width of ventral plate, weakly bilobed. Valves reaching beyond the pseuduncus and tapering markedly. Transtillae: lateral arms broad; ventral arms very long, reaching beyond the saccus laterally; transverse arms fused to form a continuous strap constricted medially. Aedeagus: flask-shaped, just greater than length of the capsule; vesica with cornuti as many small denticles evenly distributed and with a plate of minute papillae as in fig. 33 (b); anellus comprising a pair of tooth-like spines with several denticles and pair of palmate plates laterally.

Female (fig. 34). Ductus bursae long, weakly sclerotised proximally with complex spiculate lobe as in fig. 34. Accessory sac small, arising from ductus medially and with terminally spiral accessory duct. Bursa copulatrix small, covered with irregular chains of pectinations on striations of the bursa; signum double comprising two equal sized ovate patches of hexagonal cells. Anterior apophyses short and broad. Posterior apophyses straight and narrow, reaching well beyond the anteriores.

Host plant: Several adults have been taken from the trunks of *Quercus* sp.

Mine: Not known.

Diagnosis. — The very large *al.ex.* and the pale ground colour separates this species from all other members of the genus except the *castaneae* group taxa. The tuft is darker than in *piperella* and the forewings less irrorate with brown, in *obrutella*. It lacks the iridescent scales of the hindwings found in *acanthella*. The saccus is more weakly bilobed than in *piperella* or *acanthella*. Compare figs. 33, 35 and 36 for other possible differences in the genitalia. See also diagnosis for *heinrichi* and *phleophaga*.

Discussion. — It is unfortunate we do not know more of the life history of this species. I (C.W.) suspect it is a bark miner. The genitalia are so very similar to those of the other oak bark miner *heinrichi* and the differences in externals, only slight, that how far they are taxonomically separate must remain in some doubt.

Originally described by Zeller (1873) as a member of *Trifurcula* Zeller, from a male and a female specimen collected by Boll in Texas. This species was also described by Chambers (1878a) from Texas material and given the name *Nepticula bosquella*. Chambers (1878b) then listed the name incorrectly as *bosqueella* (sic). Subsequently, Dyar (1903) listed *bosqueella* (sic) as a member of *Opostega* Zeller; since he gives no reason for the combination and no previous reference to the name can be traced it would seem to be an error by Dyar. Busck (1903) realised this error, also comparing material with Zeller's type of *Trifurcula obrutella* and synonymising *bosquella* with *obrutella*. Busck (1913) later reports, in his description

of *Ectoedemia castaneae*, that *obrutella* has important differences in wing venation than the type species of *Trifurcula* and he included *obrutella* in the genus *Ectoedemia*.

Distribution. — USA: — Texas, Pennsylvania, Massachusetts, Florida, Georgia, Alabama, Mississippi.

Material examined. — ♂ Type of *bosquella*: USA: “7/5; Collection of C.V. Riley; *Nepticula bosquella* Cham. Texas Ch.; Wlsm 1106 1882; Type no: 528 USNM”; slide no: CNC 3478; in USNM.

Other specimens: In MCZ — USA: Pennsylvania, Oak Station, Allegheny County; 1♂, 8.v.1913, 4♂, 2♀, 25.v.1913, 1♂, 5.vi.1910, 6♂, 2♀, 9.vi.1912 (Marloff). Pennsylvania, Jeannette; 1♂, 2.vi. (C.M. Acc. 2722, Klages). Pennsylvania, Pittsburgh; 1♂, 3.vi., 1♂, 7.vi.1904, 3♀, 20.vi. (C.M. Acc. 2723); 2♂, 3♀, 17.vi.1907 (C.M. Acc. 3495); On trunk of *Quercus* sp.; 2♂, 7♀, 17.vi.1907 (Kahl); 1♀, 17.vi.1906 (C.M. Acc. 4067, Engel). Pennsylvania, New Brighton; 1♀, 12.vi.1907, 1♂, 1♀, 14.vi.1907, 1♀, 15.vi.1907, 1♂, 27.vi.1907 (C.M. Acc. 4067). Massachusetts, Barnstable; 1♂, 26.vi.1958, 1♂, 4.vii.1958 (Kimball). In USNM—Florida, Oneco, Manatee Co.; 3♂, 5.v.1953 (Dillman). Gulf Coast Exp. Sta. Bradenton; 3♂, 1♀, 11 ex., 13—24.iii.1955 (Keisheimer). Siesta Key, Sarasota Co.; 10♂, 1♀, 9 ex., 15.iii.1953—3.iv.1960 (Kimball). Gainesville, Alachua Co.; 2♂, 14.iii.1955 (Morse), 1 ex., 1.v.1976. Pensacola; 1♂, 1 ex., 21 + 25.iii.1962, 1♂, 24.v.1964 (Hills). Mississippi, Choctaw Co.; 1♂, 22.iv.1976 (Heppner). Three other specimens probably belong here: Georgia, Crooked River St. Pk., Campden Co.; 1♂, 27.iv.1976 (Heppner). Alabama, Black Warrior River, Greenboro, Hale Co.; 1♀, 1 ex., 23.iv.1976 (Heppner).

Biology. — Immature stages unknown.

***Ectoedemia acanthella* sp.n.**

(fig. 35)

Description. — External features: ♂. Head: palps off-white; antennae pale buff; tufts on front of head and vertex dark brown; eye-caps creamy white; collar dark brown. Thorax greyish white with scattered brown scales. Abdomen greyish white, shining metallic beneath. Forewings ground colour of dorsal surface greyish white with scattered brown scales, reflecting purple; fringe creamy white, weakly lustrous. Hindwings: ground colour and fringe buff with each scale shining pale bluish purple; costa emarginated. Legs: pale buff with some gold reflections; sharp bristles of hind tibiae pronounced.

Wing expanse: Holotype 7.2 mm.

Genitalia. ♂ (fig. 35). Pseuduncus with single flattened lobe, broad. Gnathos: V-shaped; transverse ventral plate broad with medial process; dorso-lateral arms very broad and arcuate. Vinculum: lateral arms broad, ventral plate broad. Saccus strongly bilobed with centre almost reaching edge of vinculum. Valves extending just beyond pseuduncus but arising high up and tapering markedly. Transtillae: lateral arms broad; ventral arms long, but not beyond anterior edge of saccus; transverse arms fused to form continuous strap, constricted medially. Aedaegus: flask-shaped, greater than length of capsule; vesica with cornuti as many small

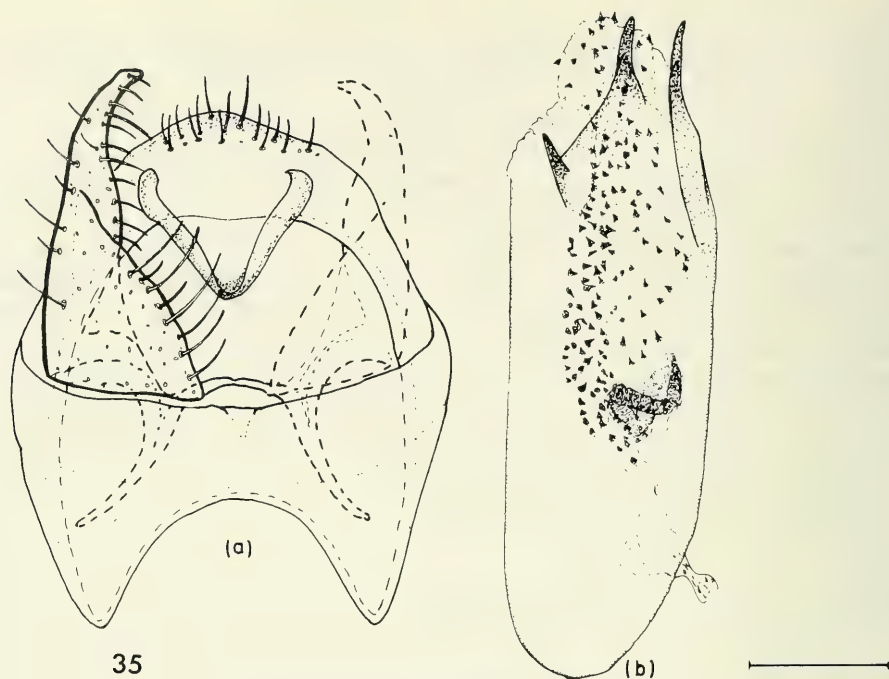


Fig. 35. *Ectoedemia acanthella* sp.n., ♂ genitalia.

denticles evenly distributed and with plate of minute papillae as in fig. 35(b); anellus comprising a number of tooth-like spines.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — External features as *obrutella* except that abdomen is creamy white. Forewings: ground colour of dorsal surface greyish white with scattered brown scales, reflecting purple; fringe creamy white, weakly lustrous. Hindwings: ground colour and fringe buff with each scale shining pale bluish purple. Genitalia as *obrutella* except that saccus is very narrow and markedly bilobed, each lobe as long as broad at base. Aedeagus: broad and regular, greater than length of capsule; vesica with cornuti as many small denticles evenly distributed and with a plate of minute papillae as in fig. 35; anellus comprising a pair of tooth-like spines but no palmate plates. Valves not so long and lack the inner corrugations and knobs of other species.

Discussion. — The differences given in the diagnosis, in particular the markedly bilobed saccus and the absence of the palmate anellar plates, exclude this specimen from *obrutella*, *piperella* sp.n., *heinrichi* and *castaneae*. The absence of inner knobs on the valves separates *acanthella* sp.n. from *phleophaga* and *mesoloba*.

Distribution. — USA: — New Jersey.

Material examined. — ♂ Holotype: USA; New Jersey, Essex County Pk.; "July 26 Trap W.D. Kearfott"; slide no: USNM 17287; in USNM.

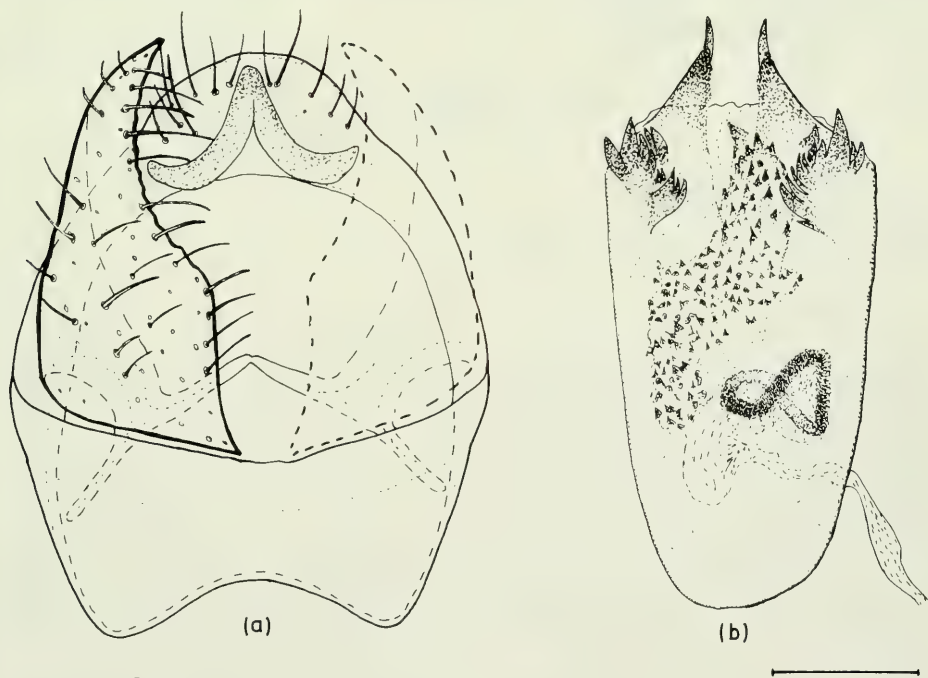
Biology. — Immature stages unknown.

***Ectoedemia piperella* sp.n.**
(figs. 36, 45)

Description. — External features: ♂. Head: palps buff; antennae pale brown; tufts on front of head and vertex orange-ochreous; eye-caps shining white; collar pale brown. Thorax yellow-cream, irrorate with purplish brown. Abdomen grey, shining metallic grey beneath. Forewings: ground colour of dorsal surface yellowish, irrorate with purplish brown scales particularly at the base and along the costal margin, reflecting purple; fringe creamy white, shining metallic grey. Hindwings: ground colour and fringe buff, shining metallic grey; pale yellow brush of ciliae at the base of the costal margin; costa emarginated. Legs: tibiae of fore and midlegs dark brown, otherwise buff and shining metallic grey behind; hind tibiae densely covered inwardly with sharp bristles. Fig. 45.

Wing expanse: ♂: 6.4–8.2 mm (3 specimens). Holotype: 7.2 mm.

Genitalia: ♂ (fig. 36). Pseuduncus with a single, broad and flattened lobe. Gnathos: an inverted V as in fig. 36(a); transverse ventral plate with large medial process; dorso-lateral arms broad and weakly arcuate. Vinculum: lateral arms broad; ventral plate broad. Saccus as wide as ventral plate, bilobed. Valves reaching beyond the pseuduncus, broad basally but tapering markedly, inner margin concave distally. Transtillae: lateral arms broad; ventral arms long and narrow, reaching beyond the ventral plate; transverse bars fused to form a continuous strap, constricted medially. Aedeagus: broad and regular in width, approx-



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Fig. 36. *Ectoedemia piperella* sp.n., ♂ genitalia.

imately equal to length of capsule; vesica with cornuti as many small denticles evenly distributed and with a plate of minute papillae as in fig. 36(b); anellus comprising a pair of tooth-like spines with several large single spines and a pair of palmate plates laterally.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — Resembles both *obrutella* and *acanthella* but differs in the more yellowish ground colour of the dorsal aspect and the more dense irroration of the forewings, in *piperella*. It lacks the iridescent scales on the hindwings found in *acanthella*. The saccus is more markedly bilobed than in *obrutella* but less than in *acanthella*. The stouter valves and the relatively short aedeagus separate this from *obrutella*.

The colours of the vertex and tufts on front of the head differ in this species from *heinrichi* and *castaneae*. It also has purple and grey reflections on the wings which are missing in these latter species. The male genitalia are similar but compare figs. 36 and 37 for differences. *E. piperella* can be diagnosed from *phleopha* and *mesoloba* by the absence of knobs on the inner surface of the valves.

Distribution. — USA: — Arkansas.

Material examined. — ♂ Holotype: USA: "Devil's Den St. Pk., Washington Co. Ark., 9.vi.1966 R. W. Hodges"; slide no: USNM 17285; in USNM. Paratypes: In USNM — USA: same data as Holotype; 3♂, 28.v.1966, 9.vi.1966, 16.vi.1966 (Hodges); slide no: USNM 17286.

Biology. — Immature stages unknown.

***Ectoedemia heinrichi* Busck**

(figs. 37, 38, 61)

Ectoedemia heinrichi Busck, 1914a: 149.

Ectoedemia heinrichi Busck; Braun, 1917: 199.

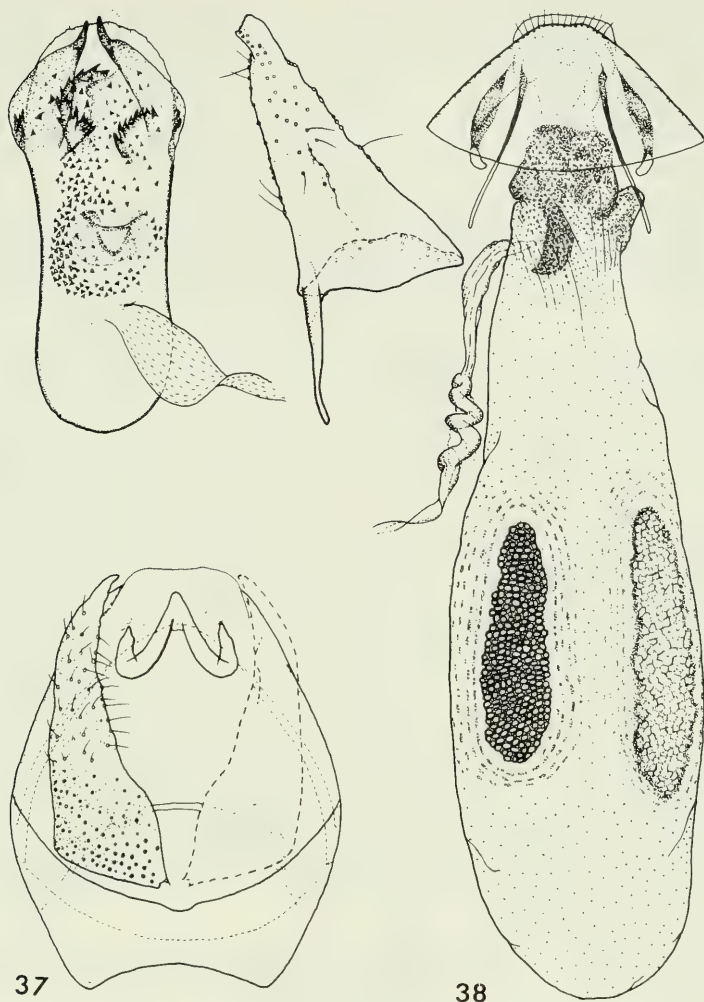
Ectoedemia heinrichi Busck; Braun in Forbes, 1923: 83.

Ectoedemia heinrichi Busck; McDunnough, 1939: 108 (no: 9786).

Description. — External features: ♂ ♀. Head: palps buff; antennae light brown; tuft on front of head and vertex dark brown; eye-caps and collar white. Thorax white with some brown-tipped scales. Abdomen pale brown. Forewings: irrorate with white and brown scales, variable on each wing as well as between specimens. Hindwings: greyish buff; undersurface brownish buff. Legs buff. Fig. 61.

Wing expanse: ♂: 8.0—10.0 mm (15 specimens); ♀: 8.0—10.5 (11). Holotype: 8.5 mm.

Genitalia: ♂ (fig. 37). Pseuduncus with a single broad lobe as in fig. 37 (a). Gnathos: W-shaped, but lateral arms shorter than inner arms. Vinculum: lateral arms broad; ventral projections narrow. Saccus broad and weakly bilobed. Valves extending as far posteriorly as pseuduncus, triangular and slightly arcuate. Transstilla: a narrow inverted U-shape; lateral arms broad and short; ventral arms narrow, projecting anteriorly well beyond margin of ventral plate; transverse bars fused to form a narrow arcuate strap. Aedeagus: approximately equal to length of



Figs. 37, 38. *Ectoedemia heinrichi* Busck, ♂ (37) and ♀ (38) genitalia.

genitalia; vesica with cornuti as small denticles and plate of minute papillae as in fig. 37(b); anellus with pair of tooth-like spines and a pair of palmate plates. Patches of scent scales present, one pair overlapping genitalia.

Female (fig. 38). Ductus bursae short, without sclerotised colliculum, but with enlarged spiculate lobe. Accessory duct arising from dilation of ductus and distally spiralled. Bursa copulatrix large, covered with pectinations; signum double, comprising two relatively small, but equal-sized patches of cells. Anterior apophyses comparatively short and broad. Posterior apophyses straight and narrow, very long, extending below swelling of ductus.

Host plant: *Quercus palustris* (Pin Oak).

Mine: An oval spiral in the bark.

Diagnosis. — This species is very similar to *castaneae*, even the larva and espe-

cially the genitalia, although *heinrichi* appears to be a slightly larger species than *castaneae*. They are very difficult to diagnose with respect to morphology, but with regard to biology, *heinrichi* mines the bark of *Quercus*, whereas *castaneae* makes galls on chestnut. Another similar species, *obrutella*, is distinguished from *heinrichi* by a darker, brown, collar and paler hindwings and there are also small differences in the male and female genitalia (see figs. 33 and 34).

Discussion. — The wing markings are variable and the genitalia similar to those of other species in the group. The life history of *heinrichi* is well known and was first worked out by Carl Heinrich and detailed by Busck (1914a). This is fortunate since its separate identity is most strongly supported by what is known of its biology.

Distribution. — USA: — Virginia, Ohio, Kentucky, Illinois.

Material examined. — ♂ Lectotype: USA: Virginia, "Falls Church, Va; Reared May 22-14, C. Heinrich; Hopk. US 12107; *Ectoedemia heinrichi* cotype Busck; USNM No. 19039; slide no. 16935; *Quercus palustris*"; in USNM. Paralectotypes: In USNM-data as lectotype; 9♂, 4♀, 1 ex., 8.v.1914 — 5.vi.1914.

Other specimens: In ANS—USA: Ohio, Cincinnati; 4♂, 7♀, 4.vi.1903, 21.vi.1904, 3.vi.1905, 15.v.1906, 30.v.1906, 7.vi.1906, 20.v.1917, 5.vi.1917, 14.vi.1917 (Braun). In USNM—USA: Illinois, Putnam Co., 1♂, 25.v.1975 (Glenn). 1♂, in ANS, data as lectotype, but not labelled cotype, was presumably given to Braun in exchange for 1♂ from Cincinnati, Ohio, 4.vi.1913, in USNM.

Mines examined: In USNM—USA: Numerous mines (and pupae) from Busck collection.

Biology. — Egg. Laid on the bark of young branches.

Mine. I have only seen this mine on the twigs of young saplings (C.W.), although Busck (1914a: 149) reported finding it also on the outer branches of larger trees. It is a narrow linear track coiled into an oval spiral with the empty egg at the centre.

Larvae. Matures in the autumn, October and November, when it leaves the mine and falls to the ground.

Pupa. Cocoon flattened, oval, reddish brown, 2—2.5 mm × 3—4 mm.

Voltinism. Univoltine. Adults normally emerge in May—June. In the laboratory specimens often emerge two or three months earlier.

***Ectoedemia castaneae* Busck** (fig. 62)

Ectoedemia castaneae Busck, 1913: 103.

Ectoedemia castaneae Busck; Braun, 1917: 198.

Ectoedemia castaneae Busck; Braun in Forbes, 1923: 83.

Ectoedemia castaneae Busck; McDunnough, 1939: 108 (no. 9784).

Description. — External features: ♂ ♀. Head: palps buff; antennae brown; tuft on front of head chocolate brown, vertex brown; eye-caps white; collar white. Thorax irrorate with brown and white scales. Abdomen brown. Forewings: ground colour of dorsal surface white, but many scales are tipped with dark brown, making the surface variously irrorate. Hindwings: brownish buff; undersurface brownish grey. Legs buff or brownish buff. Fig. 62.

Wing expanse: ♂: 6.5—8.0 mm (3 specimens); ♀: 7.0—8.0 mm (4); Lectotype: 6.5 mm.

Genitalia: ♂, ♀. Similar to those of *heinrichi* which are illustrated in figs. 37 and 38.

Host plant: *Castanea* sp. (Chestnut).

Mine: In form of small galls around young twigs.

Diagnosis. — As discussed in the diagnosis of *heinrichi*, the genitalia of both males and females of these two species are very similar; separate figures are not helpful and diagnosis on these features is too difficult. However, *castaneae* and *heinrichi* do differ in their life history and host plant and possibly also in size. Since *castaneae* is so similar to *heinrichi* in externals and genitalia the diagnosis for the latter species with respect to *obrutella* also holds for *castaneae*, which has a lighter, white, collar and darker hindwings than *obrutella* and similar small differences in the genitalia.

Discussion. — The life history of this species as a gall-former enables us to recognize its separate identity from *heinrichi*.

Distribution. — USA: — Virginia, Pennsylvania, Kentucky.

Material examined. — ♂ Lectotype: USA: Virginia, "Vietch, Va., 23 April 1913, Snyder; USNM No. 16333; slide no. 16713; *Ectoedemia castaneae* Busck cotype; 11236 Hopkins US"; in USNM. Paralectotypes: In USNM—data as lectotype; 1♂, 2♀, 23—24.iv.1913. Other specimens: In USNM—USA: Pennsylvania, New Brighton; 2♂, 2♀, 14.vi.1907 (Meyrick Museum).

Biology. — Egg. Laid on the bark of *Castanea* twigs.

Larva. Typically flattened, with limb buds on segments 3 to 10 and 13, but very rudimentary on segment 5.

Mine. No mine is made as such, but more a spherical gall resembling in form and size "the egg masses of the forest tent-caterpillar" (Busck, 1913: 103).

Voltinism. Bivoltine or, more probably, trivoltine.

***Ectoedemia phleophaga* Busck**

(figs. 39, 40, 63)

Ectoedemia phleophaga Busck, 1914b: 3.

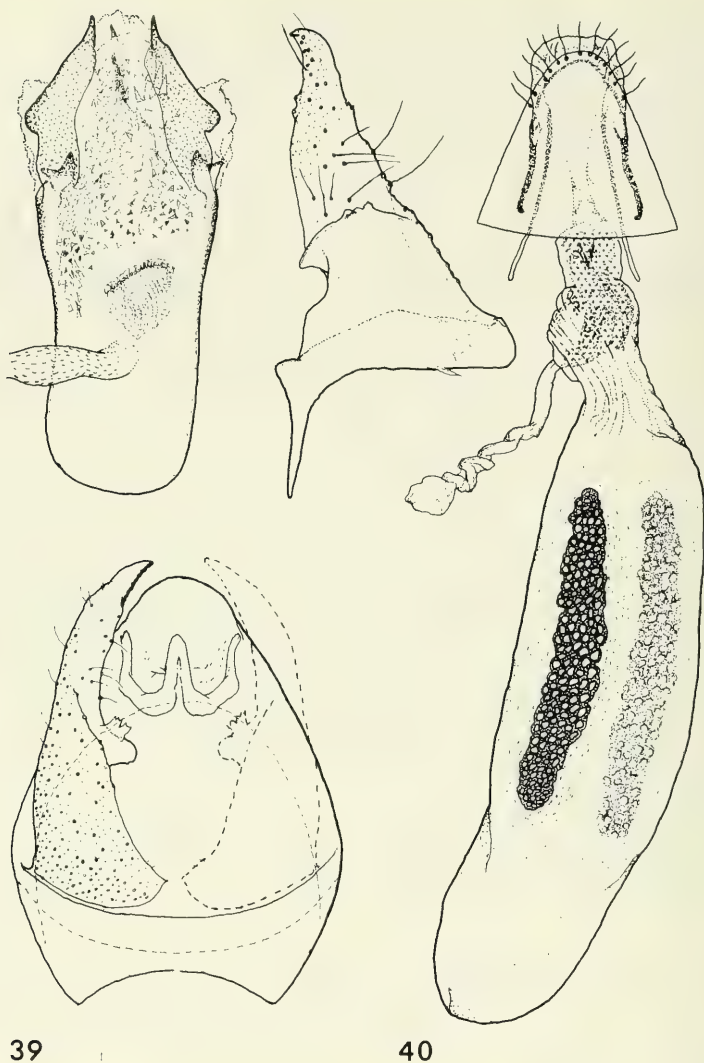
Ectoedemia phleophaga Busck; Braun, 1917: 198.

Ectoedemia phleophaga Busck; Braun in Forbes, 1923: 83.

Ectoedemia phleophaga Busck; McDunnough, 1939: 108 (no. 9785).

Description. — External features: ♂ ♀. Head: Palps buff; antennae light brown; tuft on front of head and vertex white or buff; eye-caps white; collar brown. Thorax brown. Abdomen pale brownish buff. Forewings: brown with some white scales, sometimes forming a postmedial and antemedial spot and occasionally a postmedial fascia. Thorax and basal half of forewing sometimes with dark bluish fuscous reflections. Hindwings and ventral surface brownish buff. Legs buff. Fig. 63.

Wing expanse: ♂: 8.3—10.5 mm (32 specimens); ♀: 8.7—10.6 mm (27); lectotype: 9.0 mm.



Figs. 39, 40. *Ectoedemia phleophaga* Busck, ♂ (39) and ♀ (40) genitalia.

Genitalia: ♂ (fig. 39). Pseuduncus with single rounded lobe. Gnathos: W-shaped with lateral arms as long as inner arms. Vinculum: lateral arms and ventral plate narrow. Saccus broad, weakly bilobed, concave anteriorly. Valves: fractionally longer than genitalia; narrowly arcuate, with median boss. Transtillae: lateral arms short and narrow; ventral arms short; transverse bars fused centrally. Aedeagus: equal to length of capsule; vesica with many denticles and with large plate of small papillae as in fig. 39(b); anellus comprising a pair of long, broad spines and pair of simple plates laterally.

Female (fig. 40). Ductus bursae long, colliculum not heavily sclerotised. Accessory duct arising from ductus bursae and spiral distally. Bursa copulatrix long, with

fine pectinations. Signum double, comprising a pair of long, reticulate patches, approximately equal in area. Anterior apophyses long, arcuate and narrow. Posterior apophyses very long and straight, reaching well beyond the anteriores.

Host plant: *Castanea dentata*.

Mine: A bark ophionome.

Diagnosis. — This species is similar to *castaneae* but *phleophaga* is easily distinguished by its larger size, darker wings and lighter tufts and abdomen. The white or buff tufts also distinguish it from *obrutella* and *heinrichi* in which they are dark brown. Considering the male genitalia, *phleophaga* is the only bark-miner with the inner arms of the W-shaped gnathos equal in length to the lateral arms. It also has a central boss on the middle of the valves as does *mesoloba*, in which it is more simple in form. The female genitalia are typical of the *Ectoedemia* species attacking bark described here: they lack the strongly sclerotised colliculum and have very long posterior apophyses. It is possible that *phleophaga* can be diagnosed by the anterior apophyses, which are narrower and straighter than in other similar species, especially *obrutella*, *heinrichi* and *castaneae*.

Discussion. — Again knowledge of the life history allows us to separate *phleophaga* with certainty from other species associated with bark, especially *castaneae*, which is also found on chestnut. The life history was worked out by Busck (1914b), together with Snyder and Heinrich and independently at about the same time, by Ruggles (1913). Because of its pest status (see Biology), *phleophaga* has been given the common name of "Chestnut bastminer".

Distribution. — USA: — Virginia, Pennsylvania, Massachusetts?

Material examined. ♀ Lectotype: USA: Virginia, "Falls Church Va., 22 Sept. 1913; USNM No. 16900; slide no. 16633; *Castaneae dentata*; 11245 Hopk US"; in USNM. Paralectotypes: In USNM—data as lectotype, with cotype labels; 11♂, 8♀, 12—22.ix.1913.

Other specimens: In USNM—data as lectotype; 21 ♂, 19 ♀, 2 ex., 22.vi.ii—15.ix.1914.

Biology. — Egg laid on the bark.

Mine. In the lower layers of the bark and in the cambium. A slender, contorted, serpentine mine; a number of centimetres long and a few millimetres wide, but the width varying throughout its length.

Larva. On hatching from the egg, the larva burrows in the bark until the second or third instar. By this time winter causes it to hibernate in its tunnel and activity starts again in the spring. When fully grown it is white with dark brown sclerotisations of the head capsule, thoracic, sternal and anal plates. In April to early June the larva tunnels out and drops to the ground. Only then does the tunnel become apparent by means of the exit hole.

Pupa. The cocoon is spun amongst the debris on the ground or in a burrow in loose soil. It is a reddish brown, closely woven cocoon, rather seed-like.

Voltinism. The species seems to be univoltine, the adults appearing in August and September.

Pest status. According to Ruggles (1913: 852), *phleophaga* is associated with the spread of the chestnut bark disease, *Endothia parasitica*. An enormous number of larval exit holes appear at a time of year when blight spores of the fungus are parti-

cularly prevalent (see also the Report of the State Forester of Massachusetts on the Chestnut Bark Disease, 1912).

***Ectoedemia chlorantis* Meyrick**
(figs. 41, 46)

Ectoedemia chlorantis Meyrick, 1928a: 462.

Ectoedemia chlorantis Meyrick; McDunnough, 1939: 108 (no: 9787).

Description. — External features: ♀. Head: palps pale buff; antennae buff with

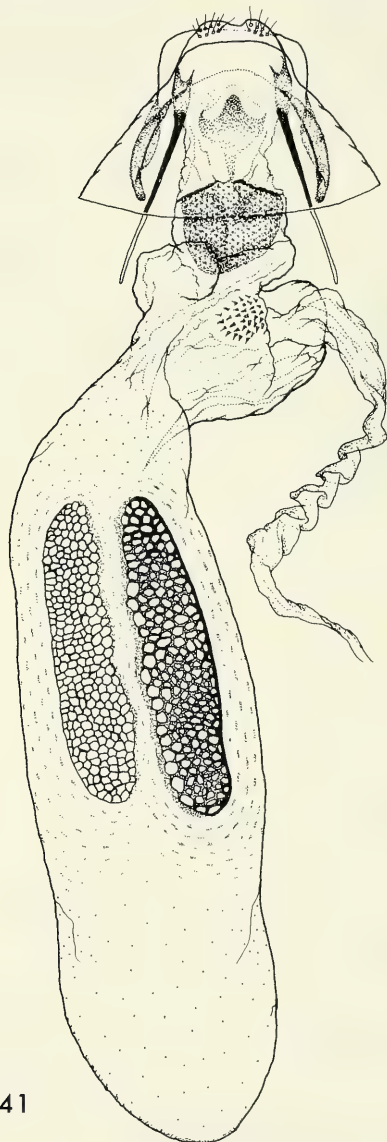


Fig. 41. *Ectoedemia chlorantis* Meyrick, ♀ genitalia.

darker banding; tuft on front of head and vertex yellowish brown; eye-caps whitish; collar brownish buff. Thorax buff, irrorate with light grey and abdomen presumably similar. Forewings yellowish buff, speckled lightly with light grey or fuscous and more heavily speckled in distal half. Hindwings and ventral surface buff, tinged with grey. Legs buff, irrorate with fuscous on outer surface. Fig. 46.

Wing expanse: Holotype: 9 mm.

Genitalia: ♀ (fig. 41). Ductus bursae short and broad, with sclerotised colliculum (not ring-shaped) and with spicules. Accessory duct spiral medially. Bursa copulatrix long, with fine pectinations; signum double, comprising two approximately equal-sized ovate patches of cells. Anterior apophyses broad and arcuate. Posterior apophyses particularly long and narrow.

Host plant: Not known.

Mine: Not known.

Diagnosis. — The forewing of *chlorantis* has light background colouring, peppered with darker irrorations, similar to that of *mesoloba*. There is not enough material to know whether there are reliable diagnostic differences in the externals of these two, but *chlorantis* is possibly a much larger species. The female genitalia of *chlorantis* lack the characteristic colliculum of most leaf- and petiole-mining species, although there is a weak sclerotisation. The long posterior apophyses are also of note as a possible indication of a bark-miner.

Discussion. — This species is only known from the female holotype, which appears to be distinct. It should be no great problem for additional material to be collected in the type-locality to provide us with better information.

Distribution. — Canada: — Ontario.

Material examined. — ♀ Holotype: Canada: Ontario, "Toronto, September (Parish)"; in BM(NH).

Biology. — Unknown.

***Ectoedemia mesoloba* Davis**

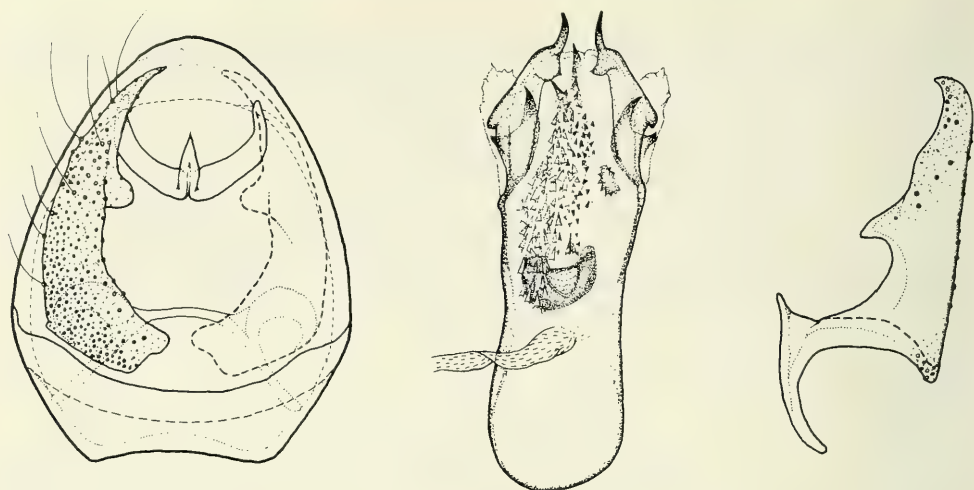
(figs. 42, 50)

Ectoedemia mesoloba Davis, 1978: 209.

Description. — External features. ♂. Head: palps buff or white; antennae whitish proximally, brown distally, but paler above; tuft on front of head, vertex and eye-caps buff to white. Thorax white with some pale brown above. Abdomen buff with much pale brown marking above. Forewings: irrorate with buff and pale brown. Hindwings and ventral surface pale buff. Legs buff with some brown scales dorsally, particularly on pro- and mesothoracic legs. Fig. 50.

Wing expanse: Holotype: 5.5 mm.

Genitalia. ♂ (fig. 42). Pseuduncus with a single, unspecialised, rounded lobe as in fig. 42(a). Gnathos: W-shaped with central boss shorter than lateral arms. Vinculum: broad and short, anteriorly slightly concave. Saccus broad and hardly concave. Valves not extending further than pseuduncus, narrow and lobed halfway along costal margin. Transtillae: strongly arcuate lateral arms broad and short; ventral arms extend well forward, beyond margin of ventral plate; transverse bars fused centrally. Aedeagus: equal in length to or slightly longer than genitalia;



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Fig. 42. *Ectoedemia mesoloba* Davis, ♂ genitalia.

vesica with large cornuti and plate of minute papillae; anellus with pair of tooth-like spines and spinose plates laterally, as in fig. 42(b).

Female: Unknown.

Host plant: Not known.

Mine: Not known.

Diagnosis. — Externally, *mesoloba* is mainly light coloured, like *chlorantis*, but *mesoloba* is very much smaller. The male genitalia have the central part of the gnathos markedly shorter than the lateral arms. This feature together with the presence of a central boss on the valves separates *mesoloba* from the other *Ectoedemia* species reported here, especially the bark-miners whose genitalia are so similar to those of *mesoloba*. There is also a boss on the valves in *phleophaga* male genitalia, but it is more complex in form.

Discussion. — Although *mesoloba* is similar to *chlorantis* the type-localities are widely separated and it seems unlikely that they occur throughout the intervening area. Davis, who recently described *mesoloba*, feels that the diagnostic features and type-locality are so characteristic that the specimen should be given specific status. It is unfortunate that more material is not available. I suspect it is a bark-miner, although it is somewhat smaller than the other bark-miner species discussed here (C.W.).

Distribution. — USA: — Florida.

Material examined. — ♂ Holotype: USA: "Pensacola, Escambia Co., Florida, Nov. 12.1961, Shirley Hills"; slide no. 16835; in USNM.

Biology. — Not known.

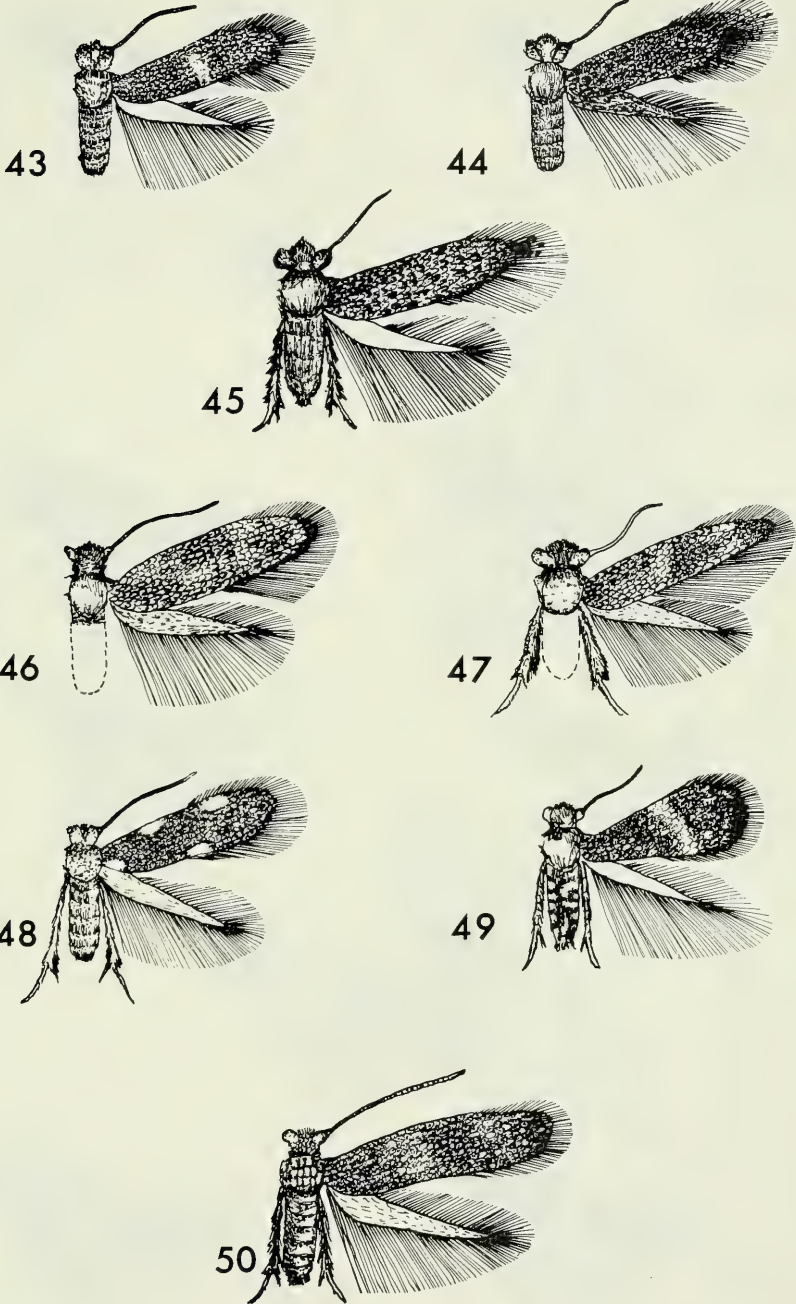
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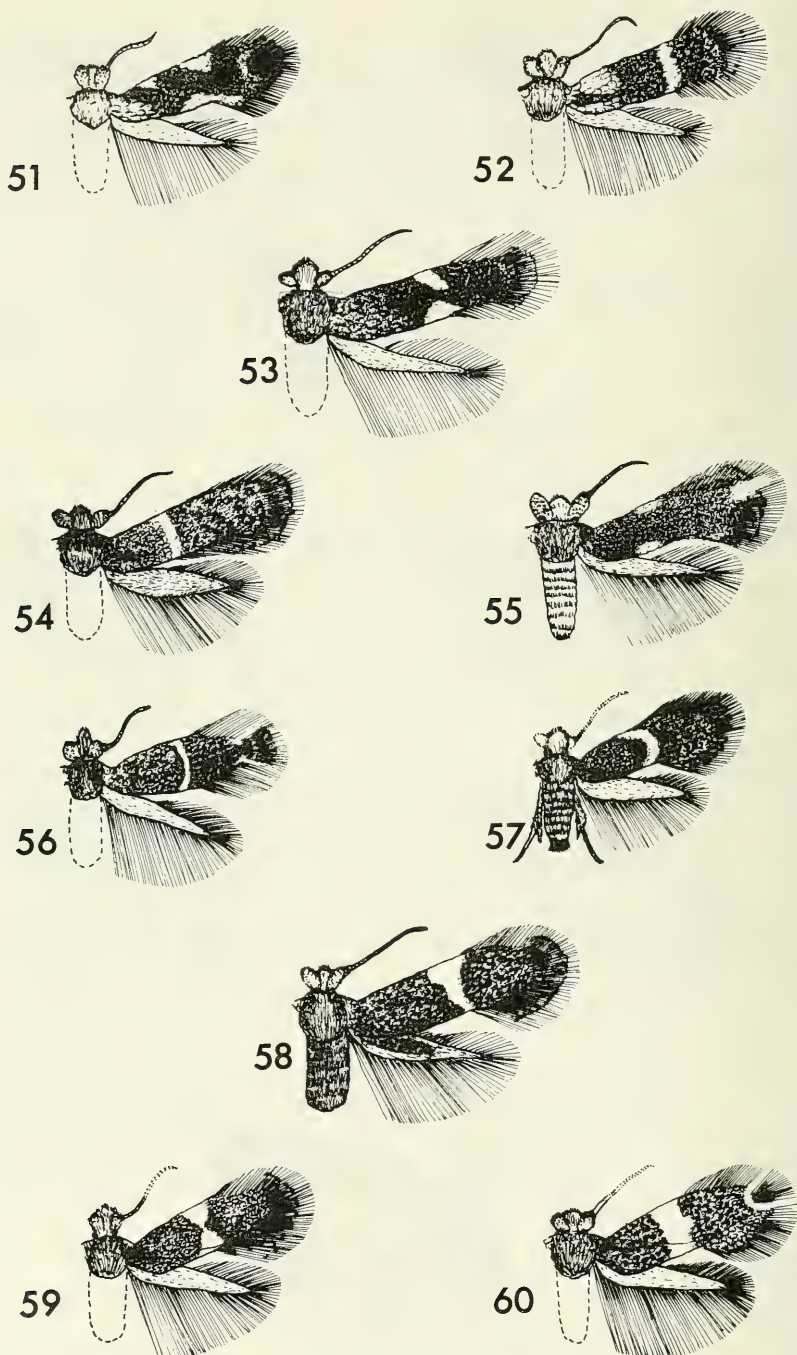
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¹⁾ Although the publication is dated Nov. 1861, it seems likely that this was the date that the Entomological Society of Philadelphia agreed on the contents for the issue. The printed copy was first received by the society's librarian on 13 Jan. 1862, so publication falls somewhere between and almost certainly close to Jan. 13. Further explanation may be found in Brown, F. M., 1964, "Dates of publication of the various parts of the Proceedings of the Entomological Society of Philadelphia", *Trans Amer. ent. Soc.* 89: 305-308.

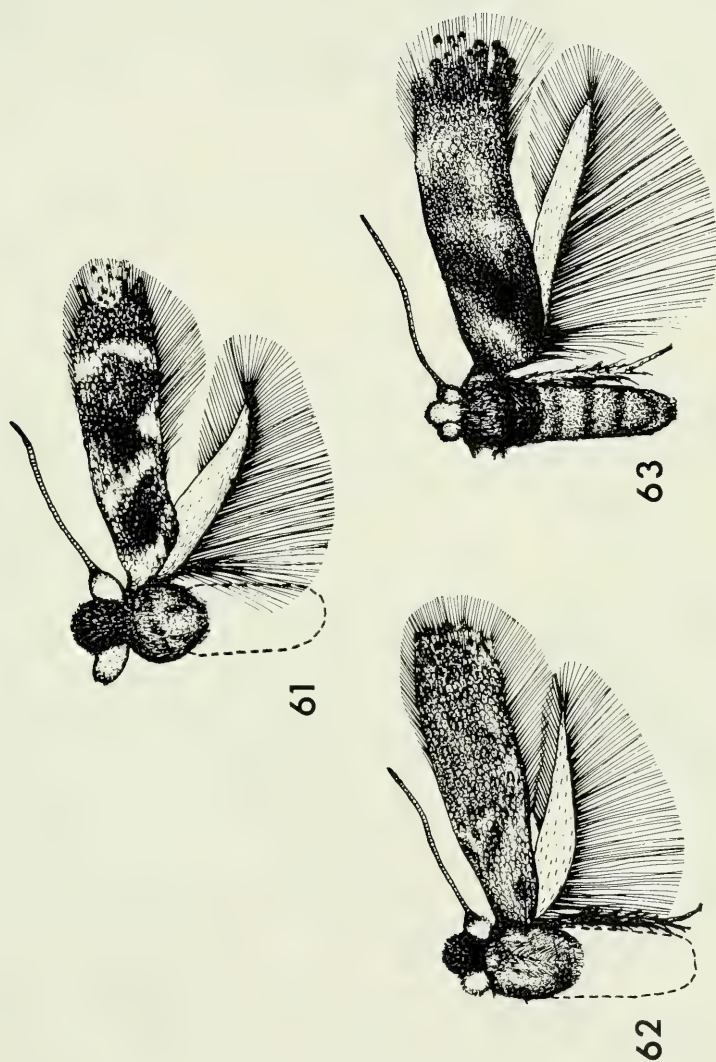
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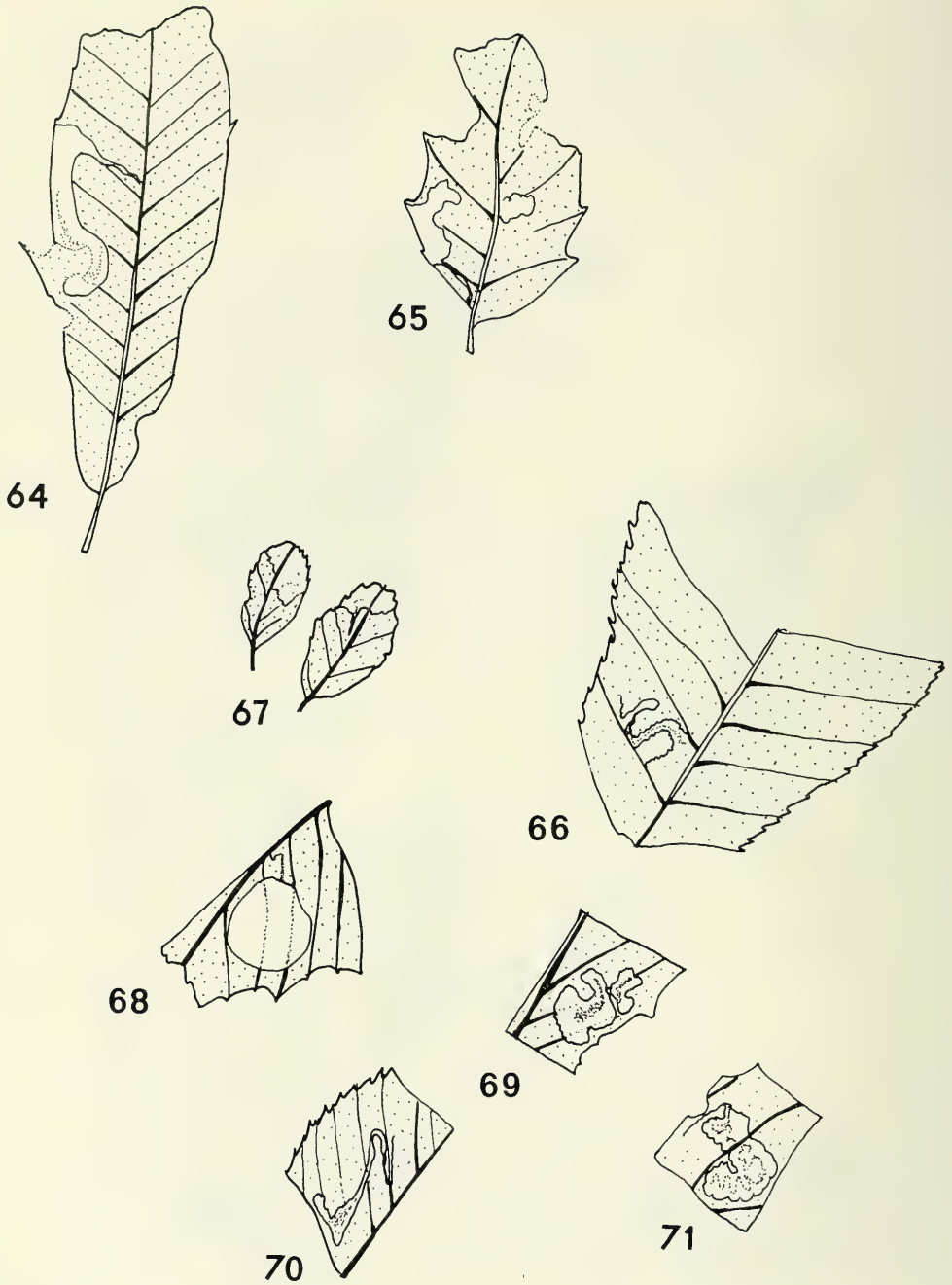
Figs. 43—50. *Ectoedemia* species, external features. 43, *E. lindquisti* (Freeman); 44, *E. canutus* Wilkinson & Scoble; 45, *J. piperella* sp.n., ♂; 46, *E. chlorantis* Meyrick, ♀; 47, *E. obrutella* (Zeller) Busck; 48, *E. quadrinotata* (Braun); 49, *E. rubifoliella* (Clemens); 50, *E. mesoloba* Davis, ♂.



Figs. 51—60. *Ectoedemia* species, external features. 51, *E. trinotata* (Braun), ♂; 52, *E. marmaropa* (Braun), ♀; 53, *E. platanella* (Clemens), ♂; 54, 55, *E. similella* (Braun), ♂, Ohio form (54) and Florida form (55); 56, 57, *E. virgulae* (Braun), ♀, Ohio form (56), ♂, Florida form (57); 58, 59, *E. nyssaefoliella* (Chambers), ♂ (58), ♀ (59); 60, specimen 8, ♂.



Figs. 61—63. *Ectoedemia* species, external features. 61, *E. heinrichi* Busck; 62, *E. castaneae* Busck; 63, *E. phleophaga* Busck.



Figs. 64—71. Leaf-mines. 64, 65, fossil leaf-mines from the lower Eocene (loaned from P. Opler); 66—71, *Ectoedemia* mines; 66, *E. trinotata* (Braun) on *Carya cordiformis*; 67, *E. marmaropa* (Braun) on *Rosa woodsii*; 68, *E. platanella* (Clemens) on *Platanus occidentalis*; 69, *E. similella* (Braun) on *Quercus palustris*; 70, *E. virgulae* (Braun) on *Corylus americana*; 71, *E. nyssaefoliella* (Chambers) on *Nyssa sylvatica*. All natural size.

A SUPPLEMENT TO THE GENUS *ECTOEDEmia* BUSCK (NEPTICULIDAE: LEPIDOPTERA) IN NORTH AMERICA, DEALING WITH SOME DIFFICULT SPECIES AND ALSO SOME NEW ONES

by

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With nine text-figures

ABSTRACT

This article attempts to shed light on some nomenclatorial problems in *Ectoedemia*. Since the monograph "The microlepidopteran genus *Ectoedemia* Busck (Nepticulidae) in North America" was written, approximately five hundred additional specimens have been made available which have provided new species and elucidated other information given here. Four problematic species are discussed, four new species are described and five significant specimens are detailed.

INTRODUCTION

In every major revision a few species names cause nomenclatorial problems. This is often because there is inadequate type material to check the names against, or no known specimens at all. The question of what to do with doubtful species usually arises during taxonomic revisionary work. The inclination is simply to cite them and leave them as doubtful in the forelorn hope that someone in the future will acquire more material. However, for the Nepticulidae it seems most undesirable to have doubtful species remaining in the literature when their identity has been suspect for more than one hundred years. Here the problems are explained, together with suggestions of how one might solve the doubtful identity of certain species. This is done with a view to seeking opinion, not only from other workers in the group but also of those who have dealt with similar situations. Four problematic species in *Ectoedemia* are dealt with and another four in the revision of the genus *Stigmella* in North America (in press).

One proposal, especially for those species described from a mine (no longer extant), with perhaps some vague reference to a larva, is to designate a neotype from an already known species — assuming that the descriptions of early stages agree. The two names then become synonymised and remain so, because of the neotype designation, and the former vague status disappears. The disadvantage is that in these cases the species may become known by the hitherto doubtful species name, if that is the older. A further suggestion which has been made to me and is an extension of the same idea, is that all already synonymised species lacking type

specimens should have neotypes designated to ensure and confirm the synonymy.

I would be pleased to hear taxonomists' views on the points raised in this article. If there is wide opinion in favour of neotype designation for the doubtful species discussed, especially those of Clemens and Chambers, they can perhaps be assigned in the Nepticulidae volume of the "Moths of North America, North of Mexico" (in preparation).

It is now very unlikely that the holotype of *Ectoedemia canadensis* (Braun) — the only known specimen — is still in existence, but curators are kindly referred to that species description (p. 94) in the hope that they will check their collections.

SUPPLEMENTARY CHECK LIST TO GENUS *Ectoedemia*

	Locality
<i>canadensis</i> Braun, 1917 (with discussion on <i>E. lindquisti</i>)	B.C., Canada.
<i>grandisella</i> Chambers, 1880	Texas, USA
<i>anguinella</i> Clemens, 1861	Kentucky, USA
<i>platea</i> Clemens, 1861	Kentucky, USA
<i>coruscella</i> sp.n.	Illinois, USA
specimen 90	Illinois, USA
<i>andrella</i> sp.n.	Maine, USA
specimens 245 and 251	Illinois, USA
<i>reneella</i> sp.n.	Florida, USA
<i>helenella</i> sp.n.	Florida, USA
specimen 180	Alabama, USA
<i>acanthella</i> Wilkinson & Newton	Florida, USA

Methods, Abbreviations and References are the same as in the preceding monograph.

All genitalia slides have been given USNM numbers, except where otherwise stated.

Acknowledgements: My thanks are due to Mej. R. Kloos and B. J. van Cronenburg for technical assistance and artwork.

***Ectoedemia canadensis* (Braun) comb.n.**

Nepticula canadensis Braun, 1917: 185.

Nepticula canadensis Braun; McDunnough, 1939: 107 (no. 9757).

Description. — External features: Head: palps dull white; antennae greyish; tuft on front of head and vertex black or very dark brown; eye-caps and collar white. Thorax black with brownish purple tinge. Abdomen dull black. Forewings: ground colour of dorsal surface very dark brown or black; single fascia, irregular in outline, white and medial in position. Hindwings: ground colour and probably fringe, grey. Legs dull black.

Wing expanse: Holotype: 5.5 mm.

Host plant: *Alnus tenuifolia* (Mountain Alder).

Mine: An upper surface ophistigmatonome.

Diagnosis. — Similar to *E. lindquisti* but the head and vertex are ochreous in this species and the fascia is more postmedial in position. The mine of *E. lindquisti* is a blotch (ophionome) and occurs on *Betula* sp. See also discussion.

Discussion. — It is most unfortunate that the only known specimen of this species — the holotype — is no longer to be found in Braun's collection, and attempts to locate it in other collections have failed. Braun was unable to say where it had gone when asked about it a few years ago. I have been to the type locality, Rogers Pass, B.C., during August 1971 and 1974 in the hope of finding new material. The locality has changed considerably since 1915 when Annette Braun made her collection, and although *Alnus* is widespread she only found specimens in one restricted place. It is not surprising, therefore, that later searches were unsuccessful. Thus there remains no known specimen to examine.

From my experience of *Ectoedemia* I have developed the strong feeling that *canadensis* almost certainly belongs to this genus and not to *Stigmella*. Further, it has striking similarities with *lindquisti* and since no one likes doubtful species remaining in the literature for many years, I at first considered the possibility of designating a neotype and then synonymising the species with *lindquisti*. Freeman (1962: 523) also recognised the similarity but the differences he gave regarding the lustreless forewings of *lindquisti* as compared with the purple reflections of *canadensis* is not correct since in certain lights strong purple and bronze iridescences can be seen on *lindquisti*, including the types. Braun in her 1917 description does not say that *canadensis* has reflections, but I believe Freeman once told me he had compared the holotype of *canadensis* with his species. The head colour of *lindquisti* is mostly pale ochreous or slightly darker, but that of *canadensis* is black, however this is not necessarily significant. In Europe the head colour varies with region and when there is debate relating to colour one should further remember the less sophisticated equipment in use at the time of the early workers.

Whilst there may well be differences in externals it is necessary to turn to the life cycle to find the most telling information. I have compared the relevant mines and rearing records from Braun's and Freeman's collections, and find them to be most significant. The fact that *lindquisti* larvae mine *Betula* whilst *canadensis* mine *Alnus* sp. cannot be overlooked, especially as Freeman (1962) says that his species has not been observed to feed on *Alnus*, even though alder occurs amongst birch in areas where *lindquisti* is very abundant. However, most importantly, if we examine the European fauna we discover that these two species have their direct homologues and therefore are most unlikely to be synonyms. *E. mediofasciella* (Haworth) in Europe corresponds with *canadensis*, whilst *E. argentipedella* (Zeller) corresponds with *lindquisti*. The North American species will key out using Emmets (1976) European key and the similarities in mine structure and host plant preferences are most striking.

E. argentipedella and *lindquisti* feed solely on *Betula* and make a similar but unusual blotch mine. Compare the figures given by Van Frankenhuijzen and De Vries (1979)¹⁾ with those of Lindquist (1962). The accounts of life cycle and biology also show a large degree of correspondence.

¹⁾ Waarnemingen aan *Ectoedemia argentipedella* (Zeller), een mineermot op berk (Lep. Nepticulidae), Ent. Ber. 39: 133.

E. mediofasciella is well known to feed on *Betula* and *Corylus* but has also been discovered in the Alps feeding on *Alnus viridis* (E. v. Nieukerken, verbal communication). The mine corresponds with that of *canadensis* which starts as a short contorted serpentine mine which later abruptly enlarges into a blotch. Compare the figure in Emmet (1976, pl. 6, fig. 12) with that of Braun (1917, pl. 6, fig. 26) as well as the descriptions of the adults. Furthermore both species may be described as very local, sometimes common in a restricted area; locally it may also be host specific.

We have found similar correspondence between other species of North American and European Nepticulidae, including genitalia structures. This work is continuing and may bring about a number of synonymies, some of which may solve taxonomic difficulties such as we have with *canadensis*.

Thus three possibilities exist for clarification of the systematic position of *canadensis*. Obviously finding new material from the type locality would be very satisfactory; synonymy with a European or North American species after designation of a neotype; or the last possibility is the remote chance that the original holotype still exists somewhere. So this constitutes a plea to those in charge of North American micro-lepidopteran collections to have a careful look to see if this specimen has finished up amongst those specimens in their care.

Distribution. — Canada: — British Columbia.

Type citation. — Holotype: Canada: B.874; Bear Creek, above Rogers Pass, British Columbia, 6000 ft., August 19, 1915, A. Braun.

Biology. — Mine. A short, narrow serpentine mine which abruptly enlarges into an irregular blotch, often filling the space between two lateral veins. Often as many as a dozen mines on one leaf. The parenchyma is entirely consumed. Distribution is very local.

Pupa. Cocoon dark brown in colour.

Voltinism. Probably univoltine.

***Ectoedemia grandisella* (Chambers) comb.n. (fig. 1)**

Nepticula grandisella Chambers, 1880: 193.

Nepticula grandisella Chambers; Dyar, 1903: 546 (listed).

Nepticula grandisella Chambers; Braun, 1917: 192.

Nepticula grandisella Chambers; McDunnough, 1939: 107 (no. 9770).

Description. — External features: ♂. Head: palps off-white; antennae brownish extending about or a little more than two-thirds wing length; tuft on front of head and vertex ochreous to dirty brown; eye-caps white. Thorax and abdomen brown, greyer beneath. Forewings: ground colour of dorsal surface brown speckled with darker brown; fringe brown. Hindwings: ground colour and fringe brownish grey. Legs brown.

Wing expanse: Holotype: 10 mm.

Genitalia: ♂ (fig. 1). Pseuduncus with single broad flattened lobe. Gnathos: V-shaped; transverse ventral plate with medial process; dorso-lateral arms broad and weakly arcuate. Vinculum: lateral arms and ventral plate broad. Saccus as wide as

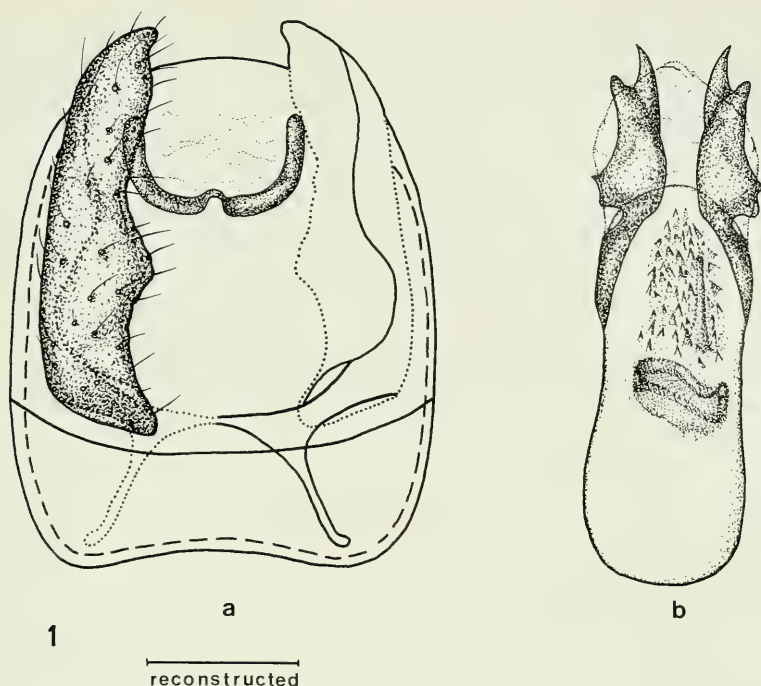


Fig. 1. *Ectoedemia grandisella* (Chambers). Reconstructed ♂ genitalia.

ventral plate, weakly bilobed. Valves reaching beyond the pseuduncus, width not varying much throughout length, inner margin somewhat concave. Transtillae: lateral arms narrow, ventral arms not long but narrow; transverse bars fused to form a continuous strap. Aedeagus: broad and regular in width, length approximately equal to that of genitalia capsule; vesica with cornuti as small denticles evenly distributed and with a plate of minute papillae; anellus comprising a pair of canine tooth-like spines as shown in fig. 1b.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — The wing markings are typical of the bark mining species. The background colour may be somewhat darker than other species or this may be due to the age of the specimen. In the genitalia, the valves seem to have a characteristic shape, as do the spines on the aedeagus.

Discussion. — This species, because of its large size and genitalia structure is likely to be a bark miner. The colour and other external features are in keeping with this suggestion. The species is transferred to *Ectoedemia* from *Stigmella* (“*Nepticula*”) for the first time.

Distribution. — USA: — Texas.

Material examined. — ♂ Holotype: U.S.A.: “Texas Cham. “*Nepticula grandisella*” “Chambers” Type 1302”; slide no. CNC 3496; in MCZ.

Biology. — Immature stages unknown.

Ectoedemia anguinella (Clemens) comb.n.

Nepticula anguinella Clemens, 1861: 85.

Nepticula anguinella Clemens; Clemens in Stainton, 1872: 175.

Nepticula anguinella Clemens; Braun, 1917: 204.

Nepticula anguinella Clemens; McDunnough, 1939: 107 (no: 9780).

Discussion. — For 120 years this species has only been known from the original description of a few lines about the mine and larva. No type material was preserved and no one has been aware of collecting the species since.

Because the larva is described as having “ten square dark brown or blackish spots” this suggests to me that the species belongs to *Ectoedemia*, this character being typical of immature instars of the genus. The black spots are lost by the time the final stage larva is reached. Therefore, we might assume that the mines described by Clemens were also incomplete. The “narrow serpentine tract which is filled or discoloured throughout its length by black excrement” could, in a mature mine, have continued by opening into a blotch so producing a typical ophistigmatonome. When a mine remains narrow and/or becomes discoloured by a mess of blackish excrement, it often indicates that the larva has been parasitised and therefore these may not be true larval characters.

It seems strange that with a type locality like Kentucky and a host-plant like oak that no one has collected it since, if indeed, it has a separate identity. Having realised that this species is described from an immature *Ectoedemia* larva on oak, it enables a more accurate comparison to be made. In fact, Clemens' original description corresponds in all points with the juvenile larva of *similella* and therefore it seems desirable to synonymise the two names. To make this permanent would necessitate the designation of a neotype for *anguinella* which would be an adult example of *similella*. Unfortunately *anguinella* would be the senior name and therefore the one to be adopted.

The advantage of the scheme is obvious — it would fix a name which has been in doubt for 120 years, and if it seems a desirable procedure it will be adopted in the forth'coming Nepticulidae volume of the “Moths of North America, North of Mexico”.

Ectoedemia platea (Clemens) comb.n.

Nepticula platea Clemens, 1861: 85.

Nepticula platea Clemens; Clemens in Stainton, 1872: 175.

Nepticula platea Clemens; Braun, 1917: 204.

Nepticula platea Clemens; McDunnough, 1939: 107 (no: 9781).

Discussion. — There is less evidence for the identity of this species than for *anguinella* and not so much justification for regarding it as *Ectoedemia*. On the other hand, it may be said that that provides all the more reason to do something positive to remove it from its dubious status. There is nothing in the original description to suggest that this “species” represents anything other than a healthy mature larva of the preceding species *anguinella*. The larva is described as purplish with a pale green vascular line and a row of reddish brown dorsal dashes. *Ectoe-*

demia quinquella Beddell in Europe is yellow with a row of large spots on the venter, as in *anguinella*. These spots are shed early in the final instar and the larva is then pale greenish white with a bright green gut line and a chain of small linear dashes on the venter — the larva mines ventral side up. This is now similar to *platea*, except for the background colour — purple. As Braun (1917: 204) points out, the purple colour of the larva is not conclusive, as the colour is often produced in larvae which feed on leaves with autumnal colouration.

I have examined the larvae and/or descriptions of the twelve or so north American Nepticulidae which feed on oaks, or have been recorded on them. Most can be eliminated for one reason or another as possibly conspecific with *platea*; of the rest the most feasible and likely proposition, on present evidence, is that *anguinella* and *platea* are synonyms — the descriptions, therefore, representing different stages in the growth of the larvae. If this seems a reasonable proposition a formal synonymy can be made in the "Moths of North America, North of Mexico".

***Ectoedemia coruscella* sp.n.**

(fig.2)

Description. — External features: ♂. Head: palps off-white; antennae buff; tuft on front of head and vertex brown; eye-caps white; collar brown. Thorax and abdomen light brown, shiny. Forewings: ground colour of dorsal surface buff or light brown, heavily speckled with dark brown, iridescent scales; these are less dense sub-basally, and sub-terminally a pair of light buff triangular spots exist without

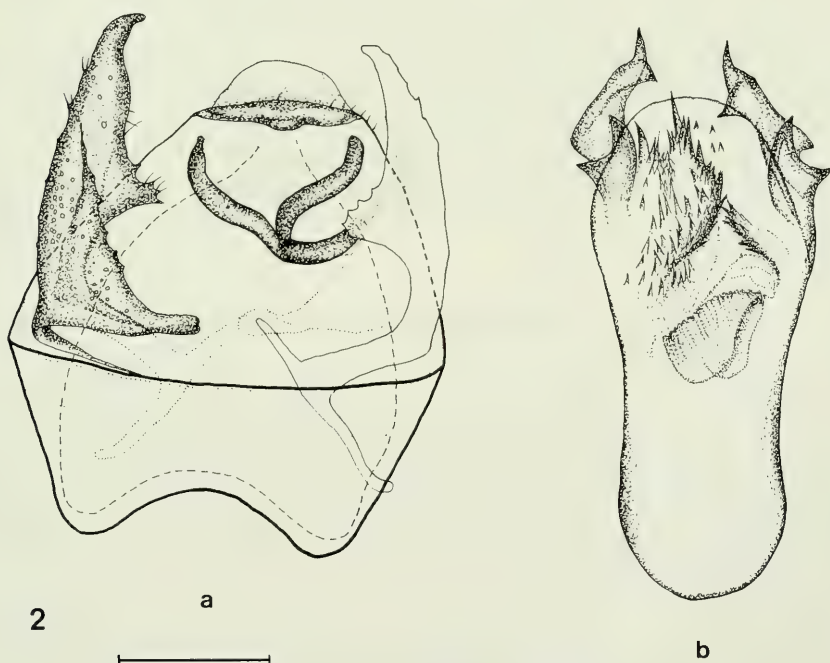


Fig. 2. *Ectoedemia coruscella* sp.n., ♂ genitalia.

the darker scales; one spot is costal, the other anal; fringe brownish-grey, lustrous. Hindwings: ground colour and fringe shiny brownish grey. Legs buff.

Wing expanse: Holotype: 7 mm.

Genitalia: ♂ (fig. 2). Pseuduncus with single, rounded but flattened lobe. Gnathos: W-shaped but central projection unusually long. Vinculum: broad laterally and ventrally. Saccus bilobed but not markedly so. Valves arising high on capsule and extending just beyond pseuduncus; inner margin highly irregular with medial papillate protuberance. Transtillae: with lateral arms well developed; ventral arms extending to edge of saccus; transverse arms medially constricted. Aedeagus: flask-shaped; vesica with extremely spinose cornutus and papillate plate as in fig. 2b; anellus comprising two pairs of bifurcate spines.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — This species is externally typical of other members of its group, but can be diagnosed from others treated here and in the foregoing revision by the pair of triangular postmedial wing patches. The male genitalia shows the valves, aedeagus and perhaps the gnathos to be characteristic.

Discussion. — This species is similar to a number of bark miners, but the absence of palmate anellar plates excludes this species from *obrutella*. On the other hand, the aedeagus is far more spinose than that of *acanthella*. The vinculum and saccus also have a different shape and the valves have a unique inner margin. Perhaps *mesoloba* has the most similar male genitalia to those of *coruscella* but *mesoloba* has a smaller central boss on the gnathos and somewhat smaller valves. The wings appear to lack the triangular patches of *coruscella*.

Distribution. — USA: — Illinois.

Material examined. ♂ Holotype: USA: Illinois, "Putnam Co., Aug. 14.1960; M.O. Glenn"; slide no. 21817; specimen no. 250; in USNM.

Biology. — Unknown. Possibly bark miner which may explain why a northern states species is only now discovered, and by so little material. It is not surprising that the mines of bark miners have remained largely unnoticed and therefore the life cycles are mostly unknown.

Ectoedemia specimen 90

(fig. 3)

Description. — External features: ♂. Head: palps buff; antennae light brown; tuft on front of head and vertex darker brown; eye-caps white; collar brown. Thorax and abdomen brown with some white scales. Forewings: ground colour of dorsal surface brown, irrorate and speckled with white scales, a patch of white medial in position and smaller flecks elsewhere. Hindwings: ground colour and fringe brownish-grey. Legs buff.

Wing expanse: ♂: 8 mm (1 specimen).

Genitalia: ♂ (fig. 3). Pseuduncus with single broad and flattened lobe. Gnathos: W-shaped but central boss approximately half length of outer arms. Vinculum: broad laterally and ventrally. Saccus only weakly bilobed. Valves arising one third

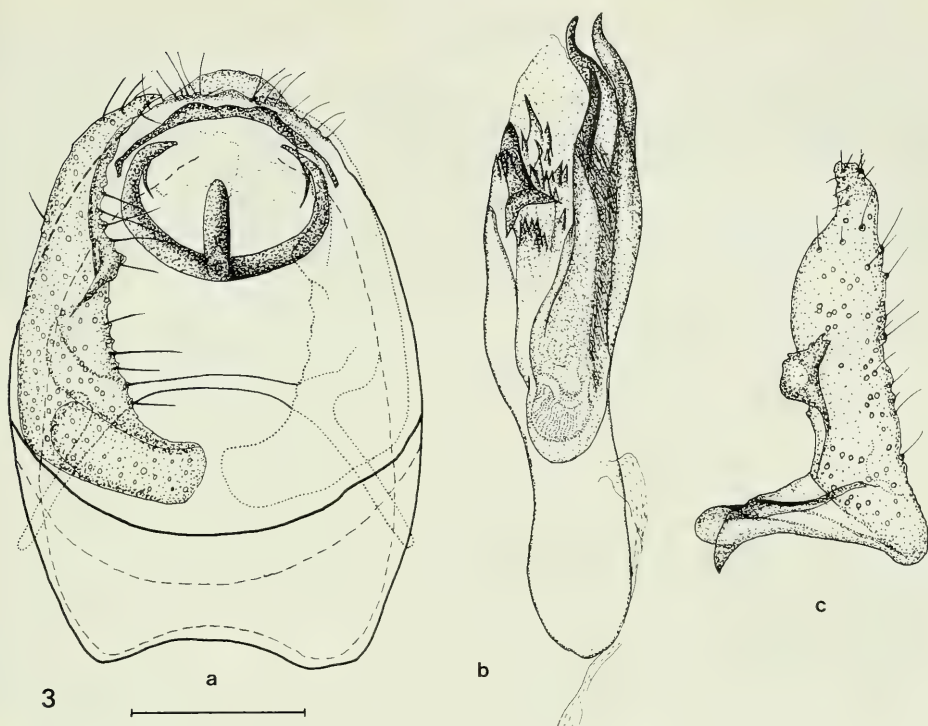


Fig. 3. *Ectoedemia* specimen 90, ♂ genitalia.

up genital capsule and extending barely as far as pseuduncus; inner margin papillate. Transtillae: lateral arms short and robust; ventral arms long, extending beyond capsule; transverse arms united to form a strap. Aedeagus: as long or longer than capsule; vesica with spinose cornutus and papillate plate; anellus comprising a number of very long spines as in fig. 3b.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — This specimen appears to have highly diagnostic characters in the genitalia, even if not in the externals. Whilst the gnathos and valves are similar to the preceding species *coruscella*, they are not identical and the aedeagus is very different. *E. coruscella* has characteristic spots on the wings.

Discussion. — The male genitalia of this species are quite different from those of all other species dealt with here or in the preceding monograph. The nearest are those of the preceding species which also comes from the same locality. More material is obviously urgently needed to clarify the species these specimens represent. There is no information as to how this material was obtained.

Distribution. — USA: — Illinois.

Material examined. — USA: Illinois, Putnam Co., 1 ♂, 14.vii.1968? (or 1960?). M. O. Glenn; slide no. 20752; specimen no. 90 in USNM.

Biology. — Immature stages unknown.

***Ectoedemia andrella* sp.n.**
(fig. 4a,c)

Description. — External features: ♂. Head: palps whitish buff; antennae buff; tuft on front of head white darkening to deep buff on vertex; eye-caps white; collar dark brown. Thorax and abdomen brown. Forewings: ground colour of dorsal surface dark brown, lighter proximally, as is each individual scale; weakly oblique medial fascia white; fringe white terminally, buff elsewhere; all weakly lustrous. Hindwings: ground colour and fringe greyish buff; a patch of buff hair scales probably androconia can be seen baso-ventrally. Legs buff.

Wing expanse: Holotype: 6 mm.

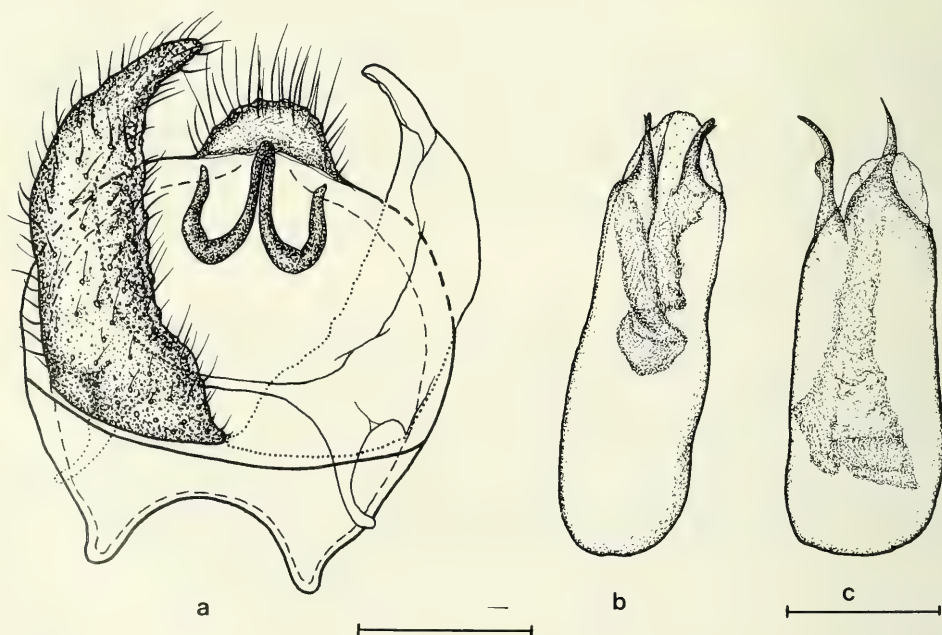
Genitalia: ♂ (fig. 4a,c). Pseuduncus rounded but prolonged posteriorly. Gnathos: W-shaped with long central projection. Vinculum: broader laterally than ventrally. Saccus small and bilobed. Valves arise low down on capsule and extend a little beyond it; tapering but regular inner margin. Transtillae: small lateral arms, longer ventral arms and well developed transverse arms forming a lateral strap. Aedeagus as in fig. 4c; flask-shaped; vesica with small denticles and papillate plate; anellus comprising two large spines, tapering markedly to a point.

Female: Unknown, but see specimen 251 following.

Host plant: Not known.

Mine: Not known.

Diagnosis. — Similar to *ulmella* but differs externally in the more dowdy appearance and weaker lustre of *andrella*. In the male genitalia the pseuduncus is



4

Fig. 4. *Ectoedemia andrella* sp.n., ♂ genitalia, a and c; *Ectoedemia* specimen 245, ♂ genitalia, a and b.

broadier and larger; the gnathos is more W-shaped and the valves more evenly tapering than in *ulmella*.

The following two specimens (245 and 251) probably also belong here. The male genitalia only differ in the spines of the aedeagus, and externally the iridescence and tufts of the head differ as does the locality. These points may not be significant.

Discussion. — Specimens 245 and 251 are in poor condition and do not warrant being made paratypes, although most of the characters can easily be seen.

Distribution. — USA: — Maine.

Material examined. — ♂ Holotype: USA: "Maine, Augusta, July 9 1940; A. E. Brower, at light." Slide no. 21819; specimen no. 98 in USNM.

Biology. — Unknown.

***Ectoedemia* specimens 245 and 251**

(figs. 4a, b, 5)

Description. — External features: ♂, ♀. Head: palps and antennae buff; tuft on front of head and vertex dark brown; eye-caps shining white; collar brown. Thorax and abdomen shining dark brown. Forewings: ground colour of dorsal surface uniform dark brown with a single shining white medial fascia; fringe dark brown but terminally white. Hindwings: ground colour and fringe greyish brown. Legs dark brown.

Wing expanse: ♂: 5.5 mm (1 specimen).

Genitalia: ♂ (fig. 4a,b). Pseuduncus rounded but prolonged posteriorly. Gnathos: W-shaped with long central projection. Vinculum: broad laterally but not so marked ventrally. Saccus small, bilobed. Valves arise low down on capsule and extend beyond it, tapering, inner margin regular. Transtillae: small lateral arms, longer ventral arms and well developed transverse arms forming a lateral strap. Aedeagus: flask-shaped; vesica with minute denticles and papillate plate; anellus comprising two large spines slightly bifurcate at tip, as shown in fig. 4b.

Female (fig. 5). Ductus bursae broad, not long, colliculum appears to be present as an indistinct loop amongst folds and associated lobes. Bursa copulatrix: very large with a pair of reticulate signa approximately equal in size. Anterior apophyses broad and unusually long. Posterior apophyses straight and narrow, short extending no further anteriorly than anteriores.

Host plant: Not known.

Mine: Not known.

Discussion. — Judging from the male genitalia these specimens almost certainly belong to the new species *andrella*. They only seem to differ in small details in the aedeagus, and these differences may only be a consequence of viewing from different angles, since the capsules appear identical. The tufts on the front of the head and vertex are much darker than in *andrella*.

Distribution. — USA: — Illinois.

Material examined. — USA: Illinois, Putnam Co., 1 ♂, 1 ♀, 14.&23.iv.1967, M.O. Glenn; slide nos. 21821 and 21822; specimen nos. ♂ 245, ♀ 251 in USNM.

Biology. — Unknown.

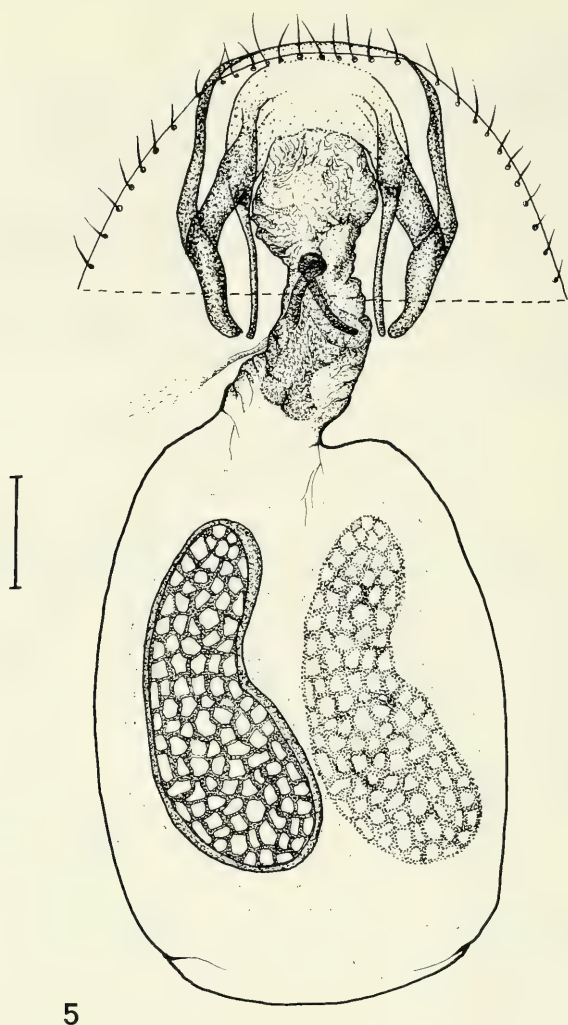


Fig. 5. *Ectoedemia* specimen 251, ♀ genitalia.

***Ectoedemia reneella* sp.n.**

(fig. 6)

Description. — External features: ♂. Head: palps, antennae off-white with little brown; tuft on front of head and vertex buff; eye-caps white; collar off-white. Thorax and abdomen lustrous white tending to buff. Forewings: ground colour of dorsal surface and fringe shining white tending to buff with very few scattered darker buff or brown scales. Hindwings: ground colour and fringe as forewings. Ventral surface both wings as upper, but more buff scales distally. Legs off-white.

Wing expanse: Holotype: 6 mm.

Genitalia: ♂ (fig. 6). Pseuduncus smoothly rounded and not prolonged posteriorly. Gnathos: W-shaped. Vinculum: comparatively narrow laterally, broad ven-

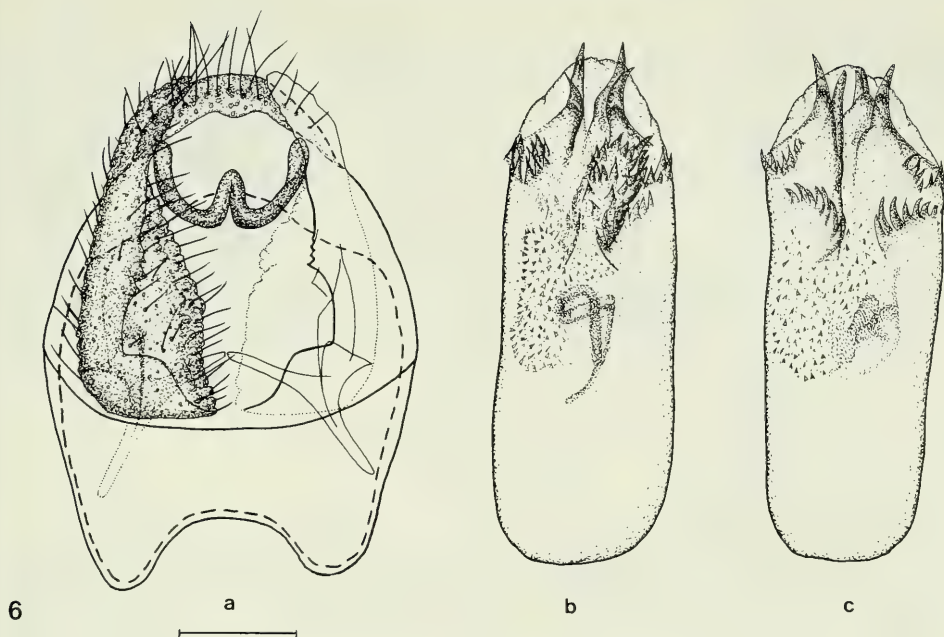


Fig. 6. *Ectoedemia reneella* sp.n., ♂ genitalia.

trally. Saccus large, bilobed. Valves arise high up capsule and do not extend beyond pseuduncus; evenly curved papillate inner margin. Transtillae: small lateral arms and long ventral arms; well developed transverse arms tapering towards centre. Aedeagus as in fig. 6b, c: flask-shaped, vesica with many denticles, papillate plates and strong spinose lobe. Anellus comprising two pairs of large spines posteriorly and two pairs of digitate processes with spines.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — This species is unusually light coloured, having no dark coloured parts. As such this could be diagnostic. The aedeagus of the male genitalia is also characteristic having two pairs of anellar spines and two pairs of spinose digitate plates. No other species known so far appears to have so much spiny ornamentation and is without internal lobes to the valves.

Distribution. — USA: — Florida.

Material examined. — ♂ Holotype: USA "Florida, Siesta Key, Sarasota Co., 1.v.1960 C. P. Kimball"; slide no. 21823; specimen no. 144 in USNM (fig. 6c). Paratype: In USNM — USA: same data as Holotype; 1 ♂, 18.iv.1960 (Kimball); slide no; 18243; specimen no. 159 (fig. 6b).

Biology. — Unknown.

***Ectoedemia helenella* sp.n.**

(fig. 7)

Description. — External features: ♂. Head: palps pale buff; antennae brown;

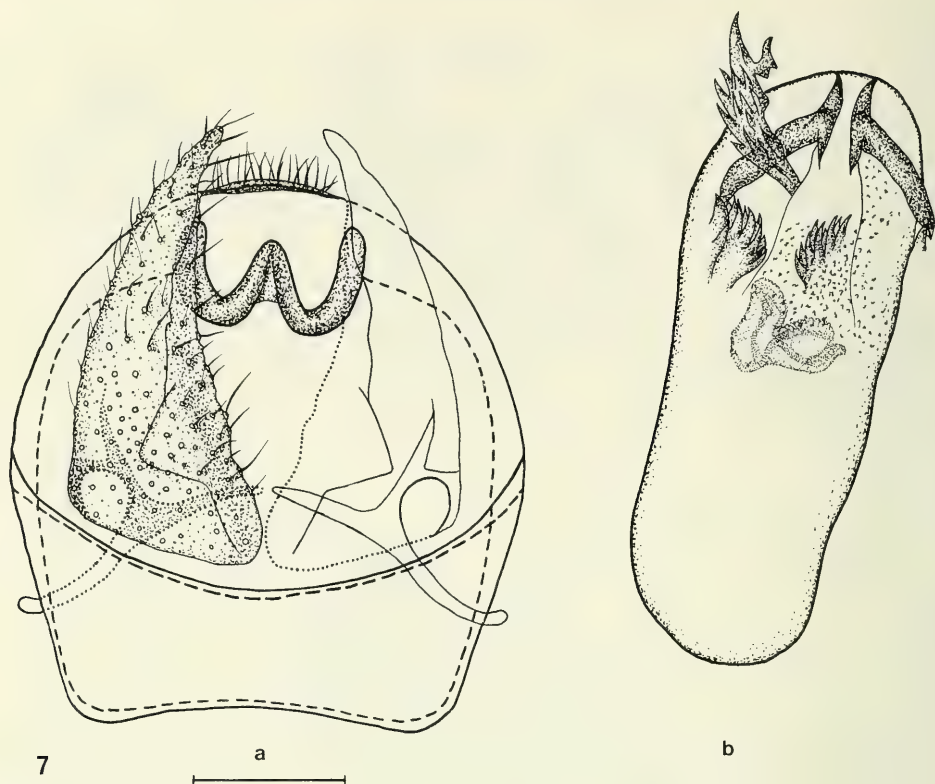


Fig. 7. *Ectoedemia helenella* sp.n., ♂ genitalia.

tuft on front of head buff, and vertex, dark brown; eye-caps, collar, thorax and abdomen brown, shiny. Forewings: ground colour of dorsal surface buff with scattered dark brown scales, iridescent bronze; lighter patches occur subbasally, shining silver especially on wing tip; fringe brown, lustrous. Hindwings: ground colour and fringe shine brownish grey. Legs buff.

Wing expanse: ♂: 6 mm (1 specimen). Holotype: 6 mm.

Holotype: 4 mm.

Genitalia: ♂ (fig. 7). Pseuduncus with single, small, rounded, flattened lobe. Gnathos: W-shaped. Vinculum: not so broad laterally but proportionately more so ventrally. Saccus very broad and not bi-lobed but slightly depressed medially. Valves long, tapering and extending beyond pseuduncus; inner margin relatively smooth and regular. Transtillae: lateral arm well developed and leading to very long ventral arms; transverse arms easily separated. Aedeagus: broad, regular; vesica with spinose cornutus and papillate plate; anellus comprising bifurcate spines and a pair of spinose palmate plates as in fig. 7b.

Female: Not known.

Host plant: Not known.

Mine: Not known.

Diagnosis. — This species is extremely small and in that resembles *mesoloba*. However, in as far as one can judge by externals this species is much darker than *mesoloba* and the valves of the genitalia differ. The genitalia are more similar to those of *heinrichi* than perhaps the illustrations would suggest, however, the size, wing-span and externals are markedly different.

Discussion. — Perhaps most closely related to *heinrichi* but very much smaller.

Distribution. — USA: — Florida.

Material examined. — ♂ Holotype: USA: "Florida, Siesta Key, Sarasota Co., 23.ii.1954, C. R. Kimball"; slide no. USNM 21818; specimen no. 155 in USNM. Paratype: In USNM — USA: Florida, Siesta Key, Sarasota Co., 1 ♂, 17.iv.1953 (Kimball); slide no. USNM 21825; specimen no. 166.

Biology. — Unknown.

Ectoedemia specimen 180
(fig. 8)

Description. — External features: ♀. Head: palps buff with dark brown scales; antennae dark brown with lighter annulations; tuft on front of head and vertex dark brown to black; eye-caps deep gold paling at edges; collar dark brown and black. Thorax and abdomen dark brown to black. Forewings: ground colour of dorsal surface uniform brown, lighter than thorax; individual scales basally grey which would give lighter appearance to worn specimens; fringe and wing edge dark buff; all weakly lustrous. Hindwings: ground colour uniform grey, markedly different from fringe and wing edge which are buff. Legs buff with dark brown scales. ♂ unknown.

Wing expanse: ♀: 12.5 mm (1 specimen).

Genitalia: ♀ (fig. 8). Ductus bursae broad with lobes and spicules; colliculum not ring-shaped. Accessory duct arising from ductus bursae and spiral medially. Bursa copulatrix long, with fine pectinations. Signum double, comprising equal-sized reticulate patches. Anterior apophyses long, arcuate and narrow. Posterior apophyses much longer, narrower and straight.

Host Plant: not known.

Mine: not known.

Diagnosis. — An extremely large species with some, so far, unique characters including the golden eye-caps, the intensely dark tufts and the striking grey hindwings edged in buff. Perhaps most like *obrutella*, *heinrichi* and *phleophaga* but the foregoing characters are clearly diagnostic. The genitalia are also similar to *obrutella*.

Distribution. — USA:- Alabama.

Material examined: — USA: "Alabama, Open Pond Cpgd. 20 mi. S. Andalusia, Covington Co., 1 ♀, 18.iv.1976 J. B. Heppner; slide no. 3029; specimen no. 180 in USNM.

Biology. — Unknown. Barkminer?

Ectoedemia specimen no. 170 ♂. Might conceivably belong to the same species at this ♀. It has white eye-caps and is smaller (11 mm). Unfortunately it is broken and the abdomen is missing.



8

Fig. 8. *Ectoedemia* specimen 180, ♀ genitalia.

Material examined. — USA: "Alabama, Black Warrior River, 13 mi. SW Greensboro, Hale Co., 1♂, 23.iv.1976 J. B. Heppner"; specimen no. 170 in USNM.

***Ectoedemia acanthella* Wilkinson and Newton**
(fig. 9)

Description. — This species has been described earlier (Wilkinson & Newton, 1981, p. 75). Two additional male specimens probably belong here, which

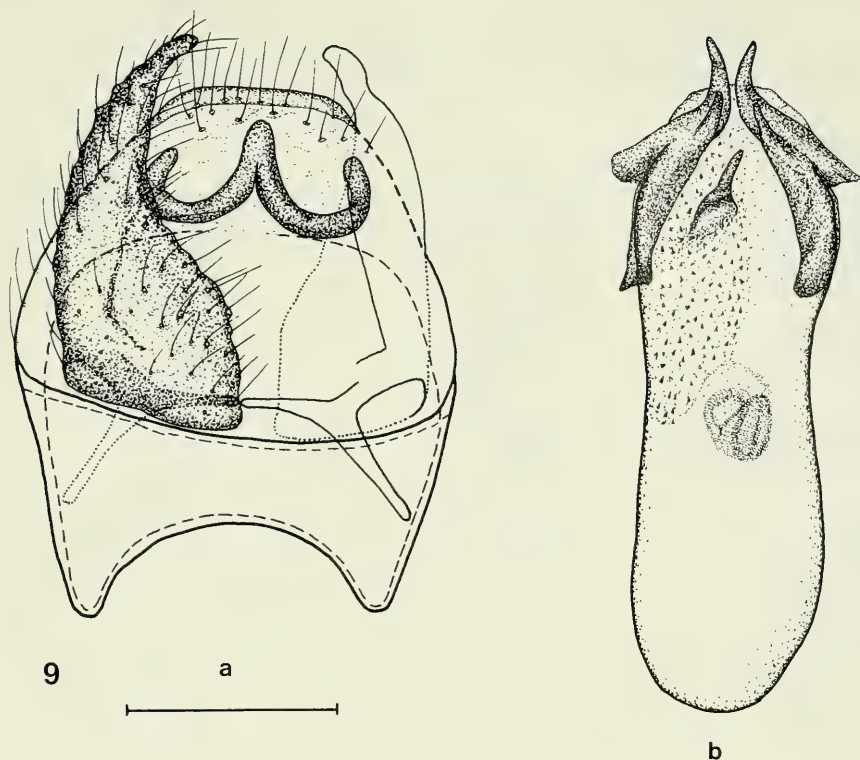


Fig. 9. *Ectoedemia acanthella*, Wilkinson & Newton, ♂ genitalia.

only became available after the original description was made and the holotype had been returned to the USNM. Therefore they have not yet been directly compared. The external features agree with the *acanthella* description. Fig. 9a, b, c, shows the male genitalia of these specimens and their similarity with fig. 35 (*acanthella* holotype) in Wilkinson & Newton (1981) can be seen. Certain features in fig. 9 not shown in fig. 35 probably clarify details of the male genitalia rather than representing characters which separate two different species. If this inference is correct then it extends the previously cited distribution to include Maine and Arkansas.

Distribution. — USA: — New Jersey, Maine, Arkansas.

Material examined. — USA: — Maine, Round Pond, 1♂, 26.vii.?, T13R12; slide no. 21826; specimen no. 176. Arkansas, Mt. Magazine, Brown Spring, 1♂, 9.vi.1964 (Clarke); slide no. 21827; specimen no. 151 in USNM.

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INHOUD

P. K. CHAUDHURI, D. K. GUHA and S. K. DAS GUPTA. — Taxonomic studies of Chironominae (Diptera, Chironomidae) from India. The genus *Polypedilum* Kieffer, p. 111—147, figs. 1—14.

TAXONOMIC STUDIES OF CHIRONOMINAE (DIPTERA, CHIRONOMIDAE) FROM INDIA. THE GENUS *POLYPEDILUM* KIEFFER ¹⁾

by

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With 14 text-figures

ABSTRACT

Fourteen species of non-biting midges belonging to the genus *Polypedilum* Kieffer are described or revised from six geophysical zones of West Bengal, India. *Polypedilum albipalpus*, *P. ascium*, *P. chaudhurii*, *P. flagellatum*, *P. insolitum*, *P. lineatum*, *P. lucidum*, *P. nudiceps*, *P. numerus*, *P. pseudoflagellatum*, *P. rufomarginalis* and *P. tripunctum* are described as new species. *Polypedilum annulatipes* Kieffer and *P. griseoguttatum* Kieffer, previously known from India and Africa, are recorded and revised in the light of modern taxonomic usages. A key to the species occurring in the state of West Bengal is presented. A check-list of Indian species of *Polypedilum* is also provided.

INTRODUCTION

Non-biting midges of the genus *Polypedilum* Kieffer are one of the most common and widespread group of insects having a fairly wide latitude of ecological tolerance, most of them occurring in lakes and lowland situations. The immatures are known to inhabit running water and places usually avoided by mosquitoes.

The material was collected mainly during the period of May, 1976 and June, 1979 with light-traps and sweeping net, while a few, as denoted, were reared in our laboratory.

Polypedilum Kieffer is a well-defined genus of the family Chironomidae. It was denoted as a genus for the first time by Kieffer (1913) on the basis of a Palaearctic species, *Polypedilum emarginatum* Kieffer, which was fixed as its type-species. Edwards (1929) treated it as a subgenus of genus *Chironomus* Meigen. Goetghebuer (1936, 1937), while accepting the idea of Kieffer, fixed *Chironomus nubeculosus* Meigen as its genotype in place of that made by Kieffer. Later, the species was found to be similar to that of Kieffer. Townes (1945) considered *Polypedilum* as a broad genus with three subgenera including *Pentapedilum* Kieffer and *Polypedilum* Kieffer and this classification was followed by most workers. Freeman (1958, 1961) accepted the view of Townes

¹⁾ Contribution no. 18 to the study of Chironomidae from the Univ. of Burdwan.

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and synonymised a large number of genera with this genus. Sublette & Sublette (1973) re-established the generic status of *Polypedilum* and placed about forty species from the Oriental Region in this genus and also kept many more species unplaced for obvious reasons. Prior to this study, only seven species had been reported from India (Kieffer, 1910, 1911d and 1913).

For explanation of morphological terminologies and abbreviations, the works of Frommer (1967), Guha & Chaudhuri (1979) and Saether (1971, 1974 and 1977) have been considered here. The figures in the first brackets in the text of the paper indicate those found in the majority instead of the average number.

Types and other specimens of this study are at present kept in the collections of insects at the Entomology Laboratory, Department of Zoology, University of Burdwan, Burdwan and will be deposited in the British Museum (Nat. Hist.), London, U.S.N.M., Washington D.C., Zoological Survey of India, Calcutta and Zoologische Staatssammlung, München (West Germany) in due time.

Again, help without which this paper could not have been completed was generously accorded by our co-workers, among whom special mention should be made of Dr. D. C. Sinharay, Mr. R. K. Debnath (Raniganj), Mr. P. Chaudhuri, Head of the Department of Zoology, University of Burdwan, is ical Survey of India, Calcutta, is sincerely thanked for kindly permitting us to examine the specimens at the Zoological Survey of India, Calcutta. Prof. D. K. Chaudhuri, Head of the Department of Zoology, University of Burdwan, is greatly acknowledged for giving laboratory facilities and permission to name a species after him.

TAXONOMIC ACCOUNT

***Polypedilum albipalpus* n.sp.**

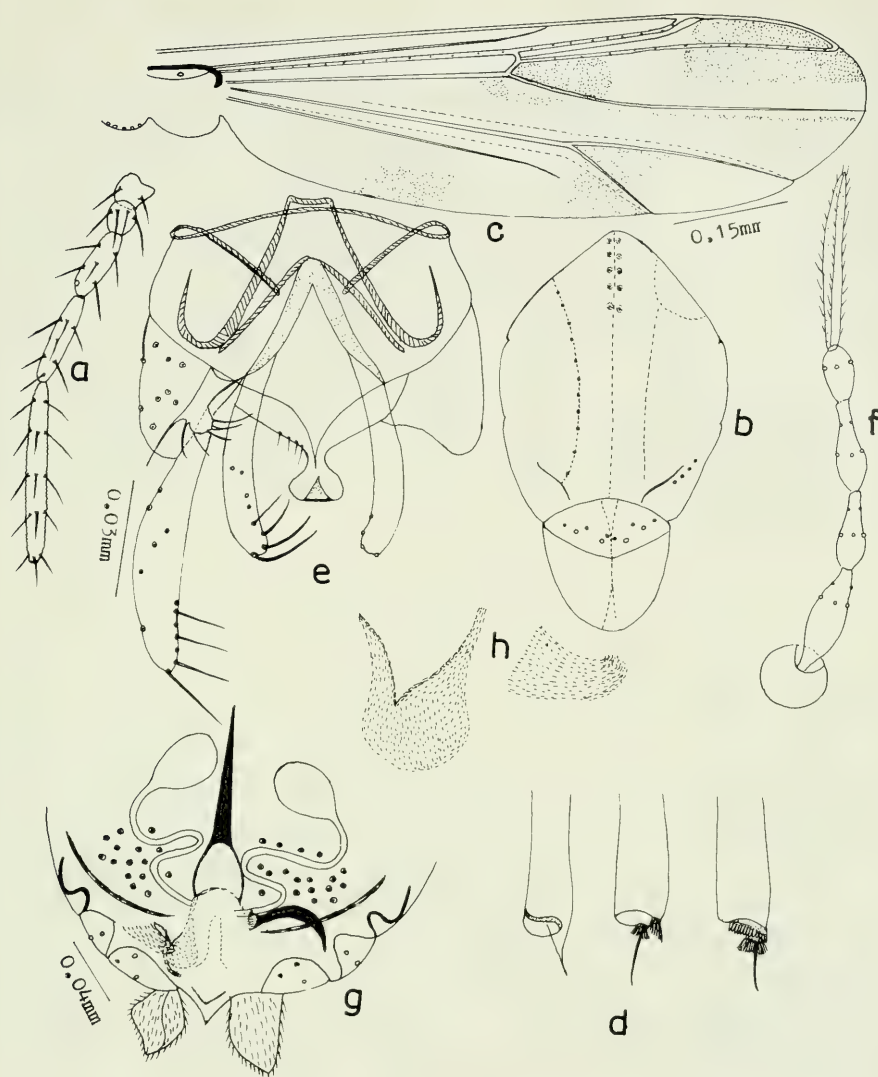
(figs. 1 a—h)

Material: Holotype ♂ (Type no. 78, B.U. Ent.), India, West Bengal, Raniganj, 10.v.1977, D. K. Guha. Allotype ♀, Burdwan, 11.iii.1978, A. Chatterjee. Paratypes: 3 ♂, 2 ♀, Burdwan, July, 1978, A. Chatterjee; 1 ♂, 1 ♀, Memari, July, 1978, P. K. Chaudhuri; 2 ♂, 3 ♀, Raniganj, August, 1978, P. K. Chaudhuri.

Remarks: This species is named *Polypedilum albipalpus* on the basis of the white colour of its palpomere V. It shows similarities in wing and male hypopygium with *Polypedilum numerus* n.sp. described in this paper and *P. aegyptium* Kieffer (1925) described by Freeman (1958) from Africa, but it can easily be distinguished as a distinct and valid species by, (i) colour and chaetotaxy of maxillary palp, (ii) spots of wing, (iii) fore tibial scale, (iv) swollen inturned anal point, and (v) appendage 2 with long setae.

Male: Body length 2.04 (1.98—2.24, n = 6) mm.

Head: Pale brown in colour. Vertex with 9 setae (postocular 1, outer verticals 7, inner verticals 1). Corona without setae. Clypeus with 14—16 setae, clypeal ratio 0.75. Maxillary palp (fig. 1a) pale brown, palpomere V whitish, palpomere III with a preapical pit bearing sensilla, length ratio of palpomeres I—V



Figs. 1a—h. *Polypedilum albipalpus* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, tibial ends of fore, mid and hind legs; e, hypopygium ♀; f, antenna; g—h, genitalia.

5:6:14:15:27, L/W ratio 3.5. Eyes almost contiguous, bare, reniform, extended dorsally, extension being 0.15 mm long. Frontal tubercle absent. Antenna brown, densely setaceous, setae longer and dense on proximal flagellomeres and gradually become shorter and sparse towards distal flagellomeres, apex of flagellomere XII without seta, length ratio of flagellomeres I—XII 10:5:5:6:7:7:7:7:7:7:65; AR 0.92. Pedicel ratio 0.8. CA 0.65, CP 1.43.

Thorax (fig. 1b): Yellow in colour. Antepronotum thin without V-shaped emargination. Acrostichals 10 arranged in pairs, dorsocentrals 11 in one row,

humeral 1, prealars 4. Scutellum with 10 setae, postscutellum light brown and bare.

Wing (fig. 1c): Cloudy with veins light yellow. Brachiolum with 1 seta. R with 14, R_1 with 9, R_{4+5} with 12 setae at the apical part; R_{2+3} meets C very close to R_1 being 0.02 mm from R_1 ; ending of R_{4+5} and C subacute; $r-m$ proximal to $f-Cu$; An ends below $f-Cu$. Wing with pale irregular spots distributed as follows: (i) one at the base of cell R_{4+5} , near $r-m$, and one linear at the apex of it, often extending to cell R_{2+3} , (ii) one very small spot near the base of M_{1+2} and one longitudinal streak present below R_{4+5} , (iii) one covering the base of cell M_{3+4} , and (iv) one at the middle and apex of cell An. Sensory organ 1 at the base of R_{4+5} . Squama with 5 setae. Haltere light brown at stem and knob and bare. Wing length 1.0 (0.98–1.14, $n = 6$) mm, breadth 0.36 (0.34–0.38, $n = 6$) mm. CR 0.91, VR 1.25. Legs (fig. 1d): Yellow to light brown. Fore tibial scale in the shape of isobilateral triangle with a spine-like apex. Spur of mid and hind tibia equal in length, being 0.043 mm long, slightly curved, ratio of length of spur to the apical diameter of mid and hind tibia 10 : 9. Tarsomere V of all legs dark. Pulvilli small and split; empodium small.

Proportions and ratios of leg segments

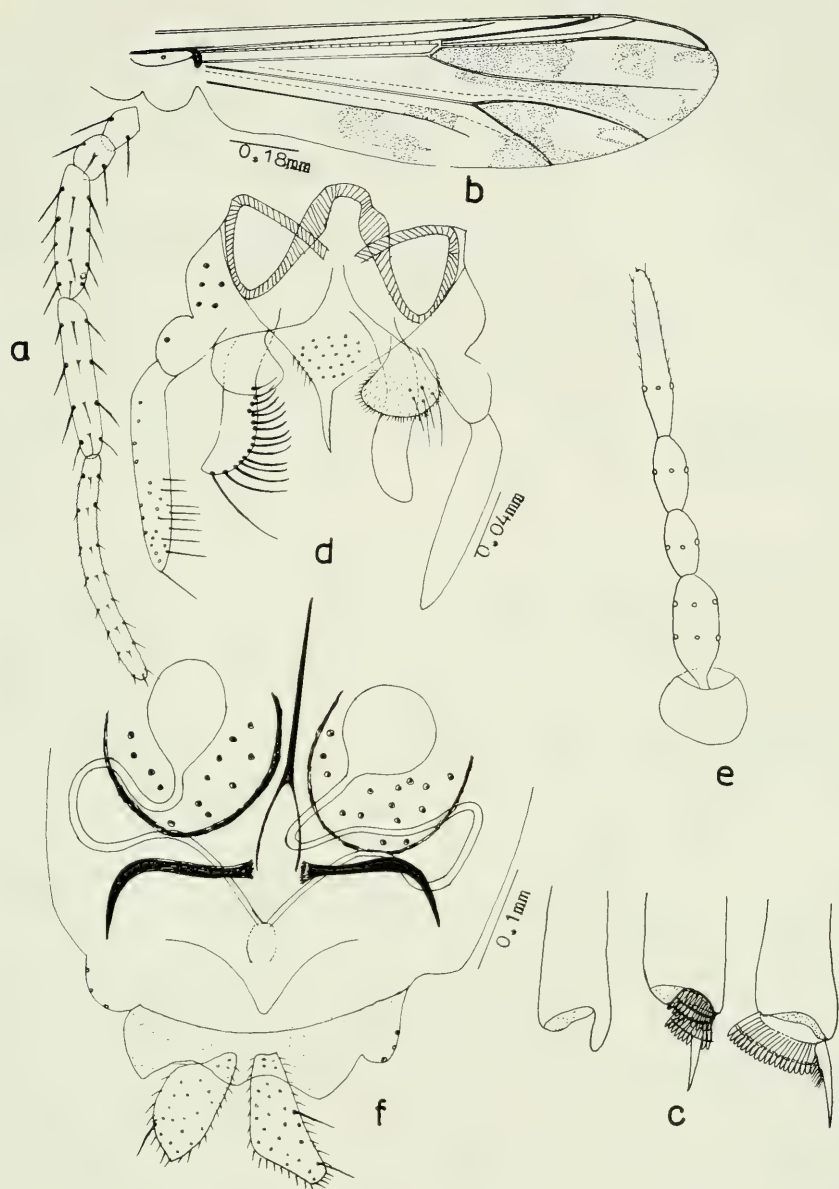
	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	24	16	28	14	10	7	5	1.75	—
Mid	29	22	14	11	8	4	4	0.63	—
Hind	30	25	18	12	9	5	5	0.72	1.5

Abdomen: Yellow with uniformly distributed setae. Segment VIII slightly constricted at the base.

Hypopygium (fig. 1e): Anal point narrow at the base and middle part wide, apex inturned, swollen and pointed, its base with 5–6 setae on each side. Gonocoxite with 8–10 (10) setae; gonostylus long, slightly bowed with 6–7 setae at its inner apical margin, gonostylus with 7–9 (9) setae over it. Appendage 1 elongated with 5–6 gently curved setae at its apex; appendage 2 long, elongated, little bent, with 7–8 (7) incurved setae at its apex. Transverse sternapodeme 0.12 mm long, lateral sternapodeme 0.09 mm long, coxapodeme 0.038 mm long and phallapodeme 0.064 mm long. HR 0.71, HV 2.55.

Female: Body length 1.64 (1.56–1.74, $n = 6$) mm.

Similar to male with usual sex differences. Antenna (fig. 1f) light brown, flagellomere V narrowed apically and with few sensilla, length ratio of flagellomeres I–V 19:13:15:9:26, AR 0.47. Wing and its chaetotaxy as in male. Wing length 1.16 (1.12–1.18, $n = 6$) mm, breadth 0.42 (0.40–0.44, $n = 6$) mm. Genitalia (figs. 1g–h): Notum 0.11 mm long. Coxasternapodeme bowed. Gonapophysis VIII divided into a broad dorsomesal and finger-like ventrolateral lobe. Apodeme lobe filamentous. Gonocoxite IX with 2 setae. Postgenital plate V-shaped. Cerci with 10–12 long and numerous small setae. Labia without microtrichia. Seminal capsules (fig. 1g) equal, oval with a neck, measuring 0.047 mm by 0.03 mm; ducts of seminal capsules with one loop and open separately.



Figs. 2a—f. *Polypedilum annulatipes* Kieffer ♂; a, maxillary palp; b, wing; c, tibial ends of fore, mid and hind legs; d, hypopygium ♀; e, antenna; f, genitalia.

***Polypedilum annulatipes* Kieffer**
(figs. 2 a—h)

Chironomus annulatipes Kieffer, 1910: 234.

Polypedilum annulatipes; Kieffer, 1921: 100; 1922: 30.

Polypedilum octostictum Kieffer, 1921: 101; 1922: 39.

Polypedilum octomaculatum Goetghebuer, 1934: 195; 1936: 488.

Polypedilum annulatipes; Freeman, 1958: 277—278.

Material: 12 ♂, 14 ♀, India, Orissa, Barkuda lake, 1.x.1922, N. Annandale (C/O Z.S.I., Calcutta); 5 ♂, 2 ♀, West Bengal, Burdwan, 11.iii.1978, A. Chatterjee; 3 ♂, Bankura, 27.ix.1977, S. Basak; 10 ♂, Coochbehar, 3.xi.1974, S. K. Das Gupta; 3 ♂, Digha, 15.iv.1976, P. K. Chaudhuri; 3 ♂, Canning, 2.iv.1976, A. De.

Remarks: This species appears to be distributed in Africa and India. It was described by Kieffer as *Chironomus annulatipes* in 1910 and as *Polypedilum annulatipes* in 1921 and 1922. The redescription of the species as presented here is based on the identified collections received from the Zoological Survey of India, Calcutta, and on those collected during the present investigation. Correlating the findings of the present authors with that of Kieffer, it may be inferred that *P. annulatipes* is a distinct species of the genus *Polypedilum* due to (i) presence of single spur in mid and hind tibia, (ii) absence of frontal tubercles, (iii) anteprenotum not collar-like and (iv) abdominal segment VIII constricted at the base.

Male: Body length 2.66 (2.52—2.69, $n = 10$) mm.

Head: Yellowish brown in colour. Vertex light yellow with 9 (postocular 1, outer verticals 5, inner verticals 3) setae. Corona without setae. Clypeus with 14—16 (15) setae, clypeal ratio 1.5. Maxillary palp (fig. 2a) pale to yellow, palpomere III with a preapical rounded pit bearing 3 cilia-like sensilla, palpomere V longest with a straight apical seta, length ratio of palpomeres I—V 8:9:26:31:46, L/W ratio 4.33. Eyes bare, crescentic, extended dorsally, extension being 0.07 mm long. Frontal tubercle absent. Antenna brown to dark brown, flagellomeres dumb-bell-shaped, flagellomere XII longest, pear-like, setae on proximal flagellomeres very long and gradually becoming shorter distad; length ratio of flagellomeres I—XII 2:2:2:2:2:2:2:2:2:2:40; AR 1.81. Pedicel ratio 1.5. CA 0.53, CP 1.13.

Thorax: Yellow with two longitudinal dark brown bands on mesonotum. Anteprenotum very thin without V-shaped emargination. Acrostichals 16 in pairs, dorsocentrals 14 in single row, humerals 2—3 (2), prealars 6. Scutellum with 8 setae in oblique row, postscutellum very dark and bare.

Wing (fig. 2b): Whitish with veins yellow and conspicuous. Brachiolium with 1 seta. R with 22, R_1 with 22 and R_{4+5} with 33—35 setae; R_{2+3} meets C very close to R_1 being 0.05 mm away from it; ending of R_{4+5} and C subacute; r—m distinct and proximal to f—Cu; An ends below f—Cu. Wing with several dark and light grey irregular spots and bands distributed as follows: (i) cell R_{4+5} with one broad linear band covering the proximal half up to r—m, one very small near the apical margin and a third one at the middle, (ii) cell M_{1+2} with one linear band or broad streaks along the mid part of M_{1+2} and one small spot sometimes found to be present at the apical margin of the cell, (iii) cell M_{3+4} with two spots, one covering the area of f—cu extending along Cu_1 up to the margin and another near the apical end below M_{3+4} , (iv) cell An with three spots, one broad at the middle of the cell, one slightly above and away from it and the third covering the area between the end of Cu_1 and its margin. Sensory organ 1 at the base of R_1 . Squama

with 10 setae. Haltere bare with yellow stem and knob. Wing length 1.51 (1.51—1.53, $n = 10$) mm, breadth 0.48 (0.44—0.48, $n = 10$) mm. CR 0.97, VR 1.27.

Legs (fig. 2c): Yellow in colour. Femur and tibia of all legs with a proximal and subapical broad bands. Fore tibial scale elongated and blunt, bearing 0—1 (1) seta. Spur of mid tibia single, curved apically, 0.051 mm long, ratio of length of spur to the apical diameter of mid tibia 14:13; spur of hind tibia single, curved apically, 0.059 mm long, ratio of length of spur to the apical diameter of hind tibia 16:14. Pulvilli split; empodium as long as claw.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	46	30	50	17	12	9	7	1.67	—
Mid	51	43	23	10	6	4	5	0.54	—
Hind	53	50	22	10	7	4	5	0.44	—

Abdomen: Intensively dark brown in colour, terga uniformly setaceous. Segment VIII narrowed at base.

Hypopygium (fig. 2d): Anal point 0.03 mm long with sharply pointed apex, anal point with 5—6 setae at each basal margin and a few setae at the base. Gonocoxite small with 6—8 long setae; gonostylus long, narrowed distally, bearing 15—20 setae over it and 10—12 (12) setae along its inner margin. Appendage 1 well developed, pad-like and minutely setaceous; appendage 2 long, bent with uniform diameter, apex slightly bent inward, bearing 15 incurved setae. Laterotergite with 10—12 (10) long setae; transverse sternapodeme 0.17 mm long, lateral sternapodeme 0.14 mm long, coxapodeme 0.07 mm long and phallapodeme 0.69 mm long. HR 0.6, HV 1.75.

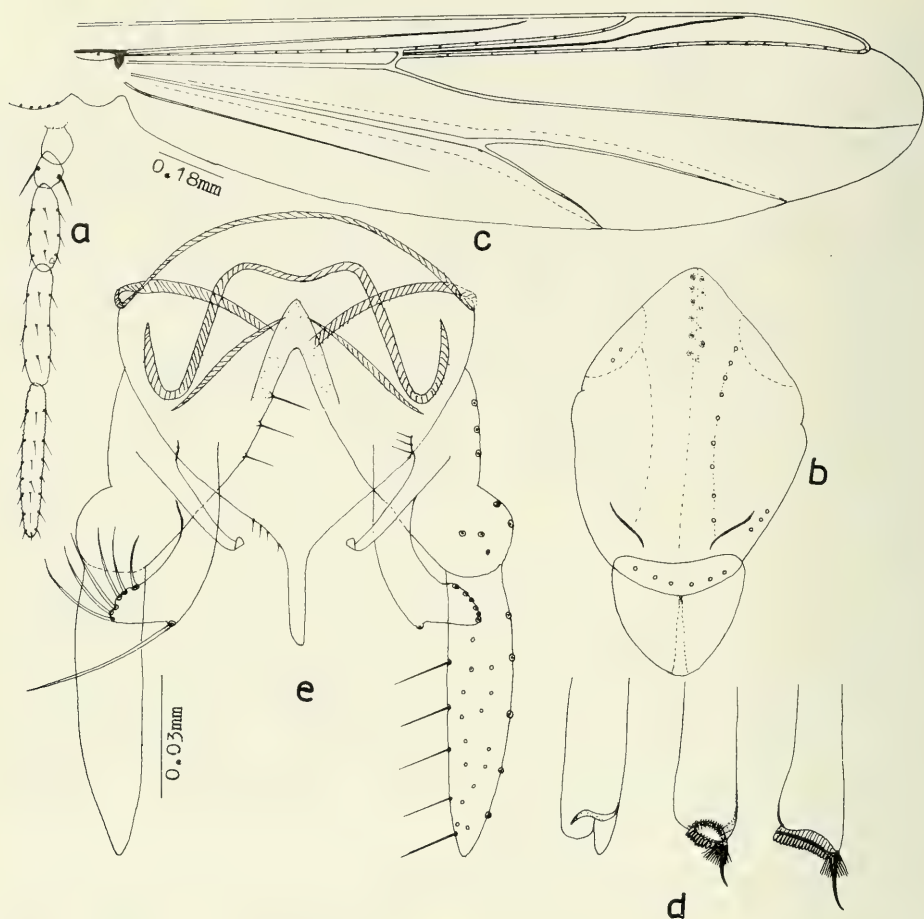
Female: Body length 1.90 (1.90—1.92, $n=8$) mm.

Similar to male with usual sex differences. Antenna (fig. 2e) dark, flagellomere V longest, length ratio of flagellomeres I—V 20:14:15:10:34; AR 0.40. Pedicel ratio 0.12. Wing with spots and bands similar to those of male but darker. Wing length 1.44 (1.41—1.44, $n=10$) mm, breadth 0.40 ($n=10$) mm. Genitalia (fig. 2f): Notum 0.012 mm long. Gonocoxapodeme wide and rounded, not joined mesally. Coxasternapodeme transverse with a single broad bend. Gonapophysis VIII divided into a broad, posteriorly directed, dorsomesal lobe and a tongue-like ventrolateral lobe bearing brush-like setae. Apodeme lobe moderately developed. Tergum IX with 5—6 long setae on each side. Gonocoxite with 4—5 (4) setae.

Postgenital plate prominently protruding and conical. Cerci toe-like and minutely setaceous. Labia elongated with numerous microtrichia. Seminal capsules (fig. 2f) unequal, oval or spherical with or without little neck, measuring 0.037 mm by 0.037 mm and 0.041 mm by 0.03 mm; ducts of seminal capsules long, coiled with one or two loops or bends and open in common to the vagina.

Polypedilum ascium n.sp.

Material: Holotype ♂ (Type no. 79, B.U. Ent.), India, West Bengal, Bolpur,



Figs. 3a—e. *Polypedilum ascium* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, tibial ends of fore, mid and hind legs; e, hypopygium.

18.viii.1977, D. Chatterjee. Paratypes; 18 ♂, data same as holotype, 18—20.viii.1977; 1 ♂, Burdwan, 3.iii.1979, S. K. Nandi; 4♂, Calcutta, 23.i.1978, D. K. Guha; 3 ♂, Rampurhat, 29.iv.1978, D. Roy.

Remarks: This species is named as *Polypedilum ascium* on the basis of the axes shaped appendage 2 of its male hypopygium. It comes near to *Polypedilum acutus* (var. *acutus*) Kieffer (1915) from the British Isles in certain features of the male hypopygium but on the basis of the detailed morphology, such as colour of the body, chaetotaxy of leg, wing and appendage 2 of male hypopygium, it is considered here a distinct species.

Male: Body length 2.4 (2.2—2.62, n=10) mm.

Head: Yellow to brown in colour. Vertex light brown with 8 (postocular 1, outer verticals 5, inner verticals 2) setae. Corona without setae. Clypeus with 16—18 setae, clypeal ratio 1. Maxillary palp (fig. 3a) brown, palpomere III with a preapical pit bearing 3 small sensilla, palpomere V with 3 apical setae, length

ratio of palpomeres I—V 6:7:14:18:28, L/W ratio 2.8. Eyes bare, reniform, extended dorsally, extension being 0.09 mm long. Antenna brown, densely setaceous, setae longer at proximal flagellomeres and gradually becoming shorter distad; length ratio of flagellomeres I—XII 3:3:3:3:3:3:3:3:3:3:62; AR 1.94. Pedicel ratio 1.33. CA 0.5, CP 1.5.

Thorax (fig. 3b): Brown with dark brown patches on mesonotum. Antepronotum very thin without any emargination. Acrostichals 12 arranged in pairs, dorsocentrals 9 in single row, humerals 2, prealars 3. Scutellum with 6 setae, postscutellum dark brown with a middle suture and bare.

Wing (fig. 3c): Smoky with veins yellow. Brachiolium with 1 seta. R with 11, R_1 with 5 and R_{4+5} with 16—18 setae; R_{2+3} meets C a little away from R_1 , distance being 0.08 mm; ending of R_{4+5} and C subacute; r—m oblique and proximal to f—Cu; An ends before f—Cu. Sensory organ 1 each on r—m and at the base of R_{4+5} . Squama with 5 setae. Haltere with light brown stem and dark brown knob and bare. Wing length 1.26 (1.14—1.35, $n=10$) mm, breadth 0.36 (0.32—0.40, $n=10$) mm. CR 0.94, VR 1.33.

Legs (fig. 2d): Yellow to light brown in colour. Fore tibial scale elongated and blunt, often with a short abrupt point. Spur of mid tibia single, bent at the apex, 0.05 mm long, ratio of length of spur to the apical diameter of mid tibia 13:11; hind tibia also with a spur, 0.06 mm long, ratio of length of spur to the apical diameter of hind tibia 14:12. Pulvilli very short, bilobed with a median, setaceous empodium.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	33	21	29	12	10	8	4	1.4	—
Mid	32	29	15	9	7	5	4	0.52	—
Hind	36	15	8	6	4	4	0.47	1.88	

Abdomen: Dark brown in colour, terga uniformly setaceous. Segment VIII constricted widely at the base.

Hypopygium (fig. 3e): Anal point 0.04 mm long, apex subacute slightly inflated with 5—6 setae at each basal margin and 10—12 setae at the base. Gonocoxite short with 5 long setae; gonostylus tapered with 5 long setae at its inner apical margin and with 15—20(18) long setae over it. Appendage 1 long, straight with a bent tip or incurved, bearing 3 setae at its base; appendage 2 long, axe-shaped, moderately bent at the middle, with 1 long and 6 incurved setae at its apex. Laterotergite with 16—18(18) long setae, transverse sternapodeme 0.14 mm long with a small concavity at the middle, lateral sternapodeme 0.077 mm long, coxapodeme 0.043 mm long and phallapodeme 0.055 mm long. HR 0.36, HV 1.83.

Female: Unknown.

***Polypedilum chaudhurii* n.sp.**

(figs. 4a—g)

Material: Holotype ♂ (Type no. 80, B.U. Ent.), India, West Bengal, Burd-

wan, 11.iii.1978, A. Chatterjee. Allotype ♀, data same as holotype. Paratypes: 7♂, 2♀, data same as holotype; 2 ♂, Calcutta, 23.i.1978, D. K. Guha; 1 ♂, Chinsura, 7.iii.1972, P. K. Chaudhuri; 2♂, 2♀, Durgapur, 7—8.iii.1978, S. Chaudhuri.

Remarks: This species is named after Prof. D. K. Chaudhuri, Head of the Department of Zoology, University of Burdwan, India, in appreciation of his sustained interest, enthusiasm and efforts towards the development of Biological Sciences in this University. It can be distinguished from all other species described in this paper by, (i) mottled brown thorax and its chaetotaxy, (ii) colour pattern of the wing, (iii) colour band of the legs, (iv) fore tibial scale, (v) two rows of scutellar setae, (vi) anal point with two projections, and (vii) appendages 1 and 2 of male hypopygium. This species comes near *Polypedilum griseoguttatum* Kieffer (1921) from Africa and Australia in regard to the wing and male hypopygium and to *P. prolixitarsis* Lundström (1916) as described by Edwards (1929) from Finland, but the above characters are sufficient for distinguishing from them and for determining it as a distinct and valid species.

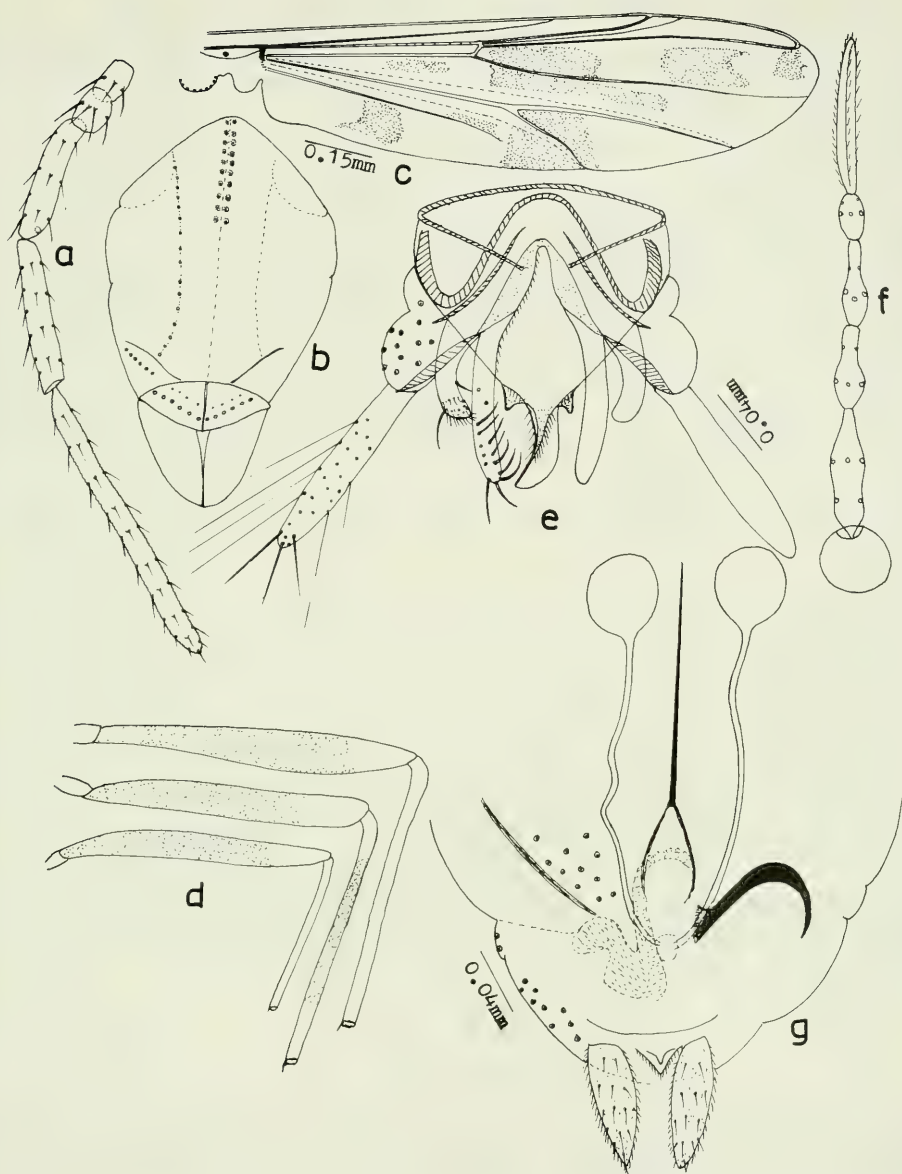
Male: Body length 2.51 (2.40—2.62, n=8) mm.

Head: Brown in colour. Vertex brown with 13 (postoculars 2, outer verticals 7, inner verticals 4) setae. Corona without setae. Clypeus with 14—16(16) setae, clypeal ratio 1. Maxillary palp (fig. 4a) light brown to pale, palpomere III with a shallow preapical pit bearing 2 long sensilla, palpomere V with an apical seta; length ratio of palpomeres I—V 10:10:28:32:52; L/W ratio 4.66. Eyes bare, crescentic, well extended dorsally, extension being 0.13 mm long. Frontal tubercle absent. Antenna pale brown, setae long in proximal flagellomeres and shorter distad, apical part of flagellomeres with only a few setae; length ratio of flagellomeres I—XII 2:2:2:2:2:2:2:2:2:2:40; AR 1.54. Pedicel ratio 1.37. CA 0.5, CP 1.17.

Thorax (fig. 4b): Mottled brown in colour. Anteprenotum very thin and without V-shaped dorsal emargination. Acrostichals 20 arranged in pairs, dorsocentrals 16 arranged in single row, humerals 2, prealars 6. Scutellum with 20 setae in two rows, postscutellum black-brown and bare.

Wing (fig. 4c): Spotted with veins yellow. Brachiolium with 1 seta. R with 18, R_1 with 15 and R_{4+5} with 20 setae; R_{2+3} meets C close to R_1 , distance being 0.04 mm from R_1 ; ending of R_{4+5} and C subacute; r—m distinct and proximal to f—Cu; An ends before f—Cu. Wing with irregular grey spots distributed as follows: (i) cell R_{4+5} with two large and one small spots, smaller spot near the apical margin, larger spots lying at the base of cell near r—m and at the middle of cell, (ii) cell M with one at the middle and cell M_{1+2} with one linear spot parallel to proximal half of M_{1+2} , (iii) cell M_{3+4} with one broad spot covering the basal margin, (iv) cell An with one broad spot at the middle, another broad spot at apex of cell and the third at the tip on An. Squama with 9 setae. Haltere with brown stem and knob and bare. Wing length 1.48 mm, breadth 0.44 cm. CR 0.96, VR 1.2.

Legs (fig. 4d): Yellow brown to dark brown. Femur dark brown with apical pale band, fore and hind tibia yellow, mid tibia dark brown with an apical and basal yellow band. Fore tibial scale triangular and pointed at the apex, bearing



Figs. 4a—g. *Polypedilum chaudhurii* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, fore, mid and hind legs; e, hypopygium. ♀: f, antenna; g, genitalia.

3—4 long setae at the base. Spur of mid tibia bent, 0.055 mm long, ratio of length of spur to the apical diameter of mid tibia 15:12; hind tibia also with bent spur, 0.059 mm long; ratio of length of spur to the apical diameter of hind tibia 16:15. Pulvilli small and split, empodium normal.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	19	11	18	9	7	4	5	1.63	
Mid	20	18	10	9	7	4	5	0.55	—
Hind	22	20	11	10	6	5	5	0.55	1.1

Abdomen: Dark brown in colour and uniformly setaceous. Segment VIII widely constricted at the base.

Hypopygium (fig. 4e): Anal point trifid, moderately stout, apex little narrowed and curved with 6—7(6) setae at each side and numerous small setae at base. Gonocoxite well developed with 12—14(13) long setae; gonostylus long, straight, distal part narrowed with 12 long setae over it and 5 setae at its inner apical margin. Appendage 1 well developed, with uniform width, gently bent at the middle, bearing 4 setae and numerous small weak setae; appendage 2 long, elongated, little bowed, apex with 12 incurved setae. Laterotergite with 4 long setae, transverse sternapodeme 0.16 mm long, lateral sternapodeme 0.09 mm long, coxapodeme 0.04 mm long and phallapodeme 0.074 mm long. HR 0.87, HV 1.62.

Female: body length 1.65 (1.62—1.68, n=4) mm.

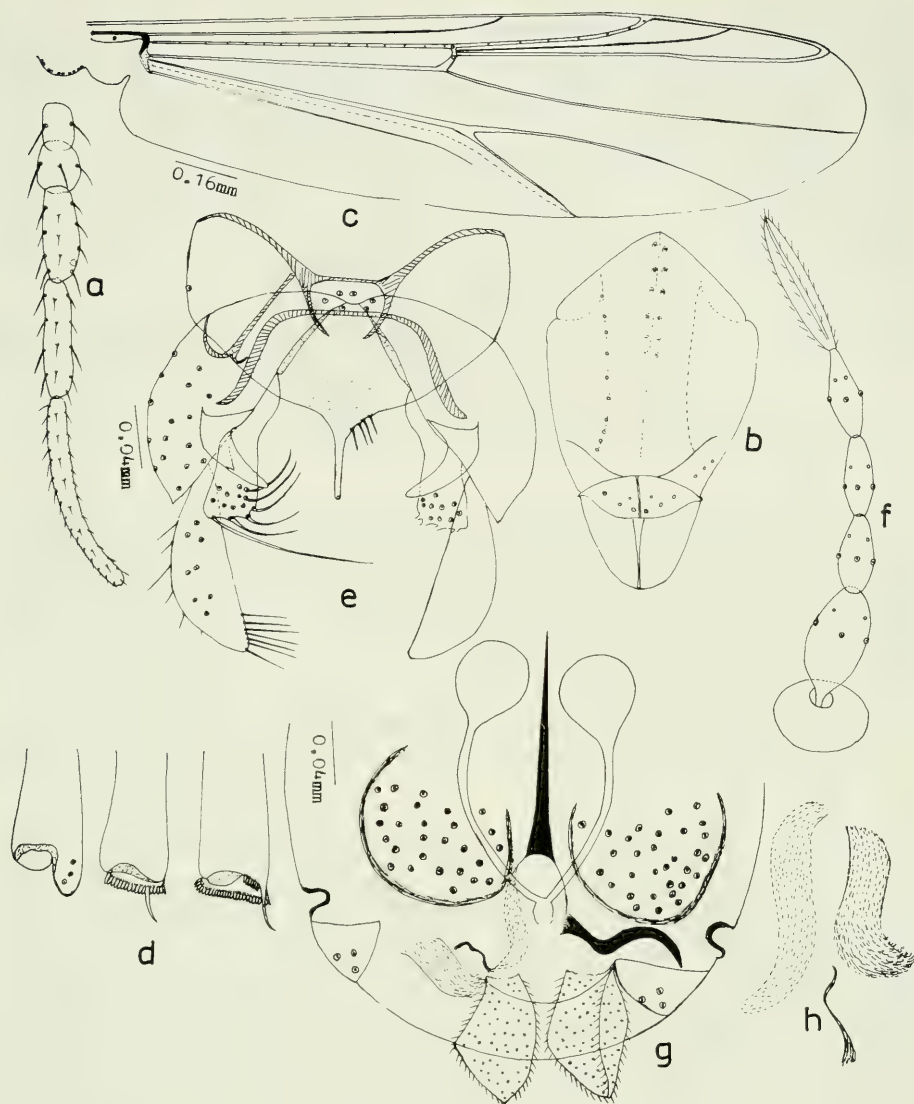
Similar to male with usual sex differences. Maxillary palp brown. Antenna (fig. 4f) yellowish, flagellomere V dark; length ratio of flagellomeres I—V 26:21:22:14:38, AR 0.40. Wing with spots and veins similar to those of female. Wing length 1.35 (n=4) mm, breadth 0.52 (0.52—0.54, n=4) mm. Genitalia (fig. 4g): Notum 0.14 mm long. Gonocoxapodeme broadened and joined distinctly at the middle. Gonapophysis VIII divided into broad dorsomesal and a small ventrolateral lobe. Apodeme lobe finger-like. Gonocoxite IX with 3 long setae. Segment X with 8 setae on each side. Postgenital plate as small protuberance. Cerci elongated. Labia with microtrichia. Seminal capsules oval or spherical, subequal, measuring 0.092 mm by 0.059 mm and 0.085 mm by 0.051 mm; ducts of seminal capsules straight with one or two bends, opening separately.

***Polypedilum flagellatum* n.sp.**

(figs. 5a—h)

Material: Holotype ♂ (Type no. 81, B.U. Ent.), India, West Bengal, Raniganj, 25.iv.1977, D. C. Sinharay. Allotype ♀, data same as holotype, date being 4.viii.1977. Paratypes: 4 ♂, Asansol, Sept., 1976, R. K. Debnath; 4 ♂, 2 ♀, Bolpur, 18.viii.1977, D. Chatterjee; 8 ♂, 3 ♀, Burdwan, June, 1977, S. K. Nandi; 1 ♂, Rampurhat, 15.viii.1977, D. Chatterjee; 3 ♂, 3 ♀, Raniganj, 25—28.iv.1977, D. C. Sinharay.

Remarks: The species is named *Polypedilum flagellatum* in view of the presence of an unusually long flagellum-like seta at the apex of appendage 2 of the male hypopygium. In certain morphological features, especially those concerning the male hypopygium, it seems to be related to a number of species such as *Polypedilum bifalcatum* Kieffer (1921, 1922) from Sudan (Africa), *P. brunneicornis* Kieffer (1911) from Italy and *P. flavescens* Johannsen (1932) from



Figs. 5a—h. *Polypedilum flagellatum* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, tibial ends of fore, mid and hind legs; e, hypopygium. ♀: f, antenna, g—h, genitalia.

Bogor, Java, Bali, Sumatra etc., but it can be considered a distinct species by virtue of, (i) presence of seta in corona, (ii) comma-shaped eye, (iii) brachiolum with 1 seta, (iv) light grey spots or bands on the wing and opaque haltere, (v) dark brown abdomen, (vi) small and bare appendage 1 and long dorsoventrally flattened appendage 2 bearing one unusually long and a number of usual incurved setae at the apex, and (vii) longer anal point with its characteristic chaetotaxy.

Male: Body length 3.61 (3.19—3.91, $n=10$) mm.

Head: Dark brown to black in colour. Vertex dark brown with 16 (postocular 4, outer verticals 10, inner verticals 2) setae. Corona well developed with 4 setae. Clypeus with 21 long setae, clypeal ratio 0.73. Maxillary palp (fig. 5a) dark brown, palpomere III with a crescentic pit bearing 2 cilia-like sensilla; length ratio of palpomeres I—V 3:3:5:7:10, L/W ratio 3.33. Eyes bare, comma-shaped, extended dorsally, extension being 0.11 mm long. Frontal tubercle absent. Antenna brown to dark brown, densely setaceous, setae longer at the proximal flagellomeres and gradually becoming shorter distad; length ratio of flagellomeres I—XI 4:2:2:2:2:2:2:2:2:48; AR 2.0. Pedicel ratio 1.2. CA 0.55, CP 1.21.

Thorax (fig. 5b): Yellow with one longitudinal band in mesonotum and two lateral bands. Antepronotum thin, collar-like without V-shaped emargination. Acrostichals 10 in pairs, dorsocentrals 11, humerals 2—3 (3), prealars 2. Scutellum with 10 setae arranged mostly in oblique row, postscutellum dark brown and bare.

Wing (fig. 5d): Yellow in colour. Femur pale. Fore tibial scale blunt and elongated bearing 4 long setae. Spur of mid tibia 0.034 mm long, ratio of length of spur to the apical diameter of mid tibia 8:12; spur of hind tibia bent apically, 0.034 mm long, ratio of length of spur to the apical diameter of hind tibia 8:14. Tarsomeres IV—V without long setae. Pulvilli split longitudinally into two narrow lobes, empodium short, with setae.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	34	29	44	27	21	17	9	1.51	—
Mid	40	35	22	11	7	6	4	0.62	—
Hind	40	41	33	17	15	9	5	0.80	1.93

Abdomen: Dark brown in colour and heavily setaceous. Segment VIII deeply constricted at the base.

Hypopygium (fig. 5e): Anal point 0.048 mm long and little narrowed with slightly pointed end, bearing 4—5 setae at its basal margin. Gonocoxite stout, narrowed and slightly attenuated at the apex, gonocoxite with 15—18 (18) long setae; gonostylus broad at base and apex narrowed with 6 small setae at its inner apical margin, gonostylus with 10—12 long setae over it. Appendage 1 bare, gently bent at the middle, its base broad and gradually narrowed; appendage 2 stout, base narrowed, dorsoventrally flattened and apex wider with 15—16 (16) long incurved setae, longest seta being 0.09 mm long. Laterotergite with 3 setae, transverse sternapodeme 0.05 mm long, lateral sternapodeme 1.2 mm long, coxapodeme 0.06 mm long, phallapodeme 0.08 mm long. HR 1.14, HV 2.20.

Female: Body length 2.61 (2.36—2.96, $n=10$) mm.

Similar to male with usual sex differences. Antenna (fig. 5f) light brown, flagellomere V dark brown, AR 0.31. Wing colour, spots as in male but darker. Wing length 1.4 (1.33—1.48, $n=5$) mm, breadth 0.51 (0.48—0.55, $n=5$) mm. Genitalia (fig. 5 g—h): Tergum 0.12 mm long. Coxosternapodeme well developed with a notch and two bends. Gonocoxite VIII joined at the middle.

Gonapophysis VIII divided into a long dorsomesal and a well developed ventrolateral lobe. Apodeme lobe weak. Tergum IX with 20—25 (24) setae, tergum X with 22—24 setae. Gonocoxite IX with 3 setae. Postgenital plate a small protuberance. Cerci long and broad with 20—25 setae. Labia without microtrichia. Seminal capsules (fig. 5g) oval, 0.044 mm and 0.048 mm; ducts of seminal capsules straight without any loops and opening separately.

***Polypedilum griseoguttatum* Kieffer**
(figs. 6a—d)

Polypedilum griseoguttatum Kieffer, 1921: 100; 1922: 36.

Polypedilum hieroglyphicum Kieffer, 1921: 101; 1922: 38.

Polypedilum decem-maculatum Goetghebuer, 1934: 195.

Polypedilum vanbemmeli Kruseman, 1949: 254.

Polypedilum griseoguttatum; Freeman, 1958: 284; 1961: 709.

Material: 2 ♂, Burdwan, 28.i.1978, D. K. Guha; 3 ♂, Calcutta, 12—13.ii.1979, P. K. Chaudhuri.

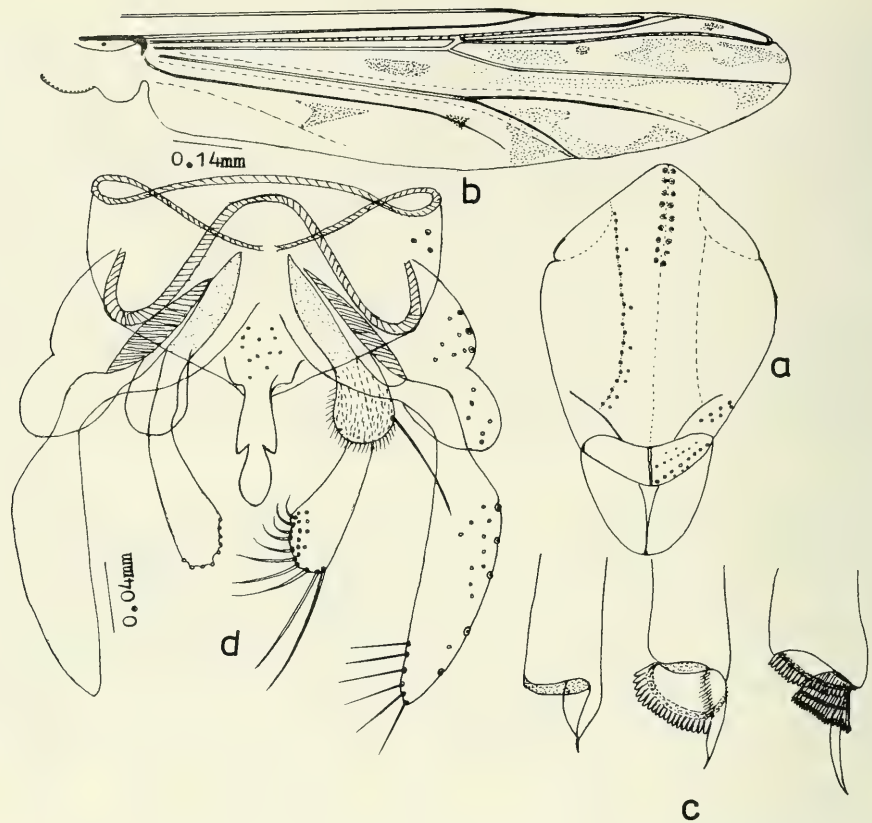
Remarks: This species was described by Freeman (1958, 1961) in both sexes from Africa and Australia. The present material, though based on only five microslide mounts of males, resembles the above species as described by Freeman. Despite the differences which exist in regard to the male hypopygium it seems unwise to consider this a separate species unless exotic material of the species is available for comparison. Pending the availability of the female specimens this species better be treated as *Polypedilum griseoguttatum* Kieffer.

Male: Body length 3.84 mm.

Head: Yellowish brown in colour. Vertex with 9 (postocular 1, outer verticals 6, inner verticals 2). Corona without setae. Clypeus with 18—19 long setae, clypeal ratio 1.2. Maxillary palp brown in colour, length ratio of palpomeres I—V 8:9:28:32:40, L/W ratio 4.6. Eyes bare, reniform, extended dorsally, extension being 0.11 mm long. Frontal tubercle absent. Antenna dark brown, densely setaceous, setae longer at proximal flagellomeres and gradually becoming shorter distad, apex of flagellomere XII without setae; length ratio of flagellomeres I—XII 2:2:2:2:2:2:2:2:2:58, AR 2.64. Pedicel ratio 1.12. CA 0.54, CP 1.2.

Thorax (fig. 6a): Brown with dark brown bands laterad. Anteprenotum very thin without V-shaped dorsal emargination. Acrostichals 28 in pairs, dorsocentrals 18, humeral 1, prealars 7, prescutellars 4. Scutellum with 36 setae in two rows, postscutellum dark brown and bare.

Wing (fig. 6b): Opaque with veins yellow in colour. Brachiolum with 1 seta. R with 32, R₁ with 22, R₄₊₅ with 35—37 setae; R₂₊₃ meets C very close to R₁, distance being 0.05 mm from R₁; ending of R₄₊₅ and C acute; r—m distinct and proximal to f—Cu; An ends below f—Cu. Sensory organ 1 on r—m. Wing with complicated pattern of dark grey spots distributed as follows: (i) one small spot distad of cell R₂₊₃ touching the margin, (ii) three in cell R₄₊₅, (iii) one at the apex of cell M and M₁₊₂, (iv) two spots in cell M₃₊₄ which appear continuous with dark, bent streak, (v) one at the middle and apex and another smaller in between



Figs. 6a—d. *Polypedilum griseoguttatum* Kieffer ♂: a, thorax; b, wing; c, tibial ends of fore, mid and hind legs; d, hypopygium.

the two. Besides the above, a linear dark streak runs below and parallel to M_{1+2} . Squama with 15 setae. Haltere bare with stem yellow and knob dark brown. Wing length 2.07 mm, breadth 0.59 mm. CR 0.96, VR 1.12.

Legs (fig. 6c): Yellow to brown in colour. Fore legs yellow except tarsomeres II—V, each of which bear a dark brown basal band. Fore tibial scale triangular bearing a sharply pointed seta at the apex. Mid and hind tibia dark brown distally. Spur of mid tibia dagger-like, slightly bent inward, 0.051 mm long, ratio of length of spur to the apical diameter of mid tibia 14:16; spur of hind tibia also like that of mid tibia, 0.062 mm long, ratio of length of spur to the apical diameter of hind tibia 17:18. Tarsomeres II—V with dark brown band, tarsomere IV with two apical spurs. Pulvilli of moderate length and split; empodium short.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	24	19	30	21	17	12	5	1.58	—
Mid	28	23	14	8	6	3	2	0.65	—
Hind	29	27	20	12	9	5	3	0.74	1.67

Abdomen: Dark brown. Terga uniformly covered with setae which are arranged irregularly. Segment VIII deeply constricted at the base.

Hypopygium (fig. 6d): Anal point well developed, tongue-like, with a constriction at the middle. Gonocoxite well developed with 12—15 (14) long setae; gonostylus long, narrowed towards apex, with 6 setae at its inner apical margin, gonostylus with 20—22 (22) long setae over it. Appendage 1 stout, broad, roughly clubbed, covered with numerous small setae over it; appendage 2 long, bowed with narrow base and apex, bearing 2 long slightly incurved setae. Transverse sternapodeme 0.23 mm long, lateral sternapodeme 0.13 mm long, coxapodeme 0.059 mm long, phallapodeme 0.14 mm long. HR 0.68, HV 1.73.

Female: Unknown.

***Polypedilum insolitum* n.sp.**
(figs. 7a—d)

Material: Holotype ♂ (type no. 82, B.U. Ent.), India, West Bengal, Digha, 15.iv.1975, P. K. Chaudhuri. Paratypes: 5 ♂, same data as holotype.

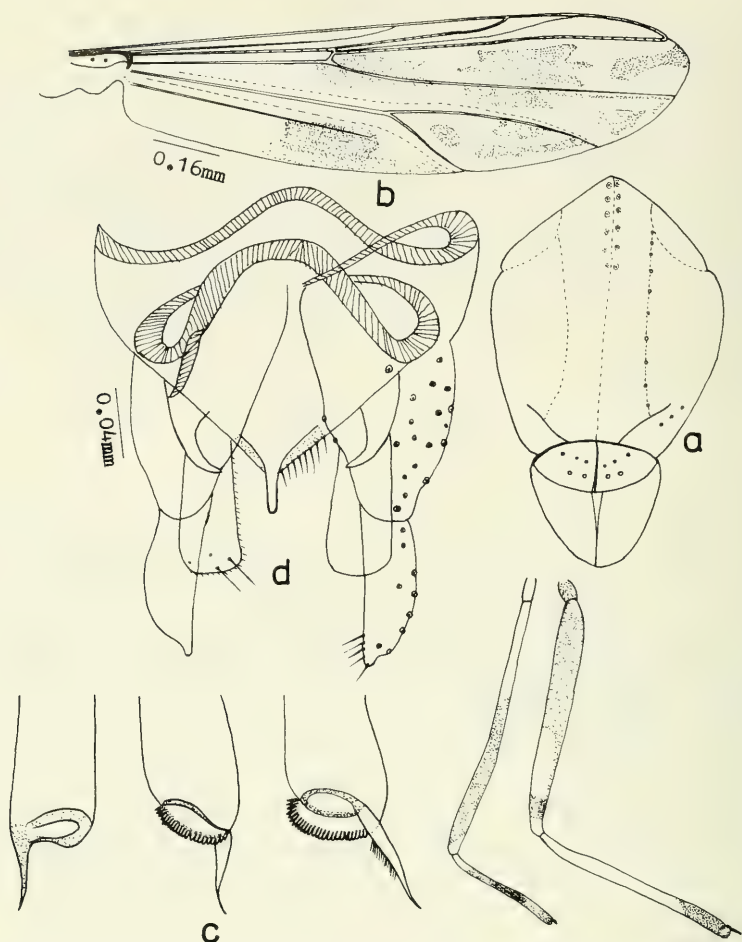
Remarks: The species is named *Polypedilum insolitum* in view of some unusual characters like the presence of a frontal tubercle and absence of setae on squama. It shows close resemblances with *Lauterborniella fuscoguttata* Kieffer (1922) from France in its wing and fore tibia, and strong similarities with *Polypedilum longinervis* Kieffer (1922) from (the then French) Cameroons in respect of the abdomen and male hypopygium but by virtue of having the characters like, (i) presence of frontal tubercle, (ii) absence of stripes on the thorax, (iii) spots of wing, (iv) femoral bands, (v) appendage 1 bare and bilobed, (vi) appendage 2 flattened without any incurved setae, (vii) segment VIII of abdomen deeply constricted at the base and (viii) gonostylus with only 5 small setae at its inner apical margin, the inclusion of the species in the genus *Polypedilum* and distinctiveness as a separate species seems to be assured.

Male: Body length 3.62 mm.

Head: Dark brown in colour. Vertex with 8 (postocular 3, outer verticals 4, inner verticals 1) setae. Corona without setae. Clypeus with 20 long setae, clypeal ratio 1.12. Maxillary palp brown to dark brown, palpomere III with a preapical pit bearing 2 flagella-like sensilla; length ratio of palpomeres I—V 4:4:9:6:11, L/W ratio 3.0. Frontal tubercles present. Eyes bare, reniform but slightly extended dorsally, extension being 0.09 mm long. Antenna dark brown to brown, length ratio of flagellomeres I—IV (rest of the flagellomeres broken in all specimens) 5:3:3:3. Pedicel ratio 0.97.

Thorax (fig. 7a): Brown with dark brown patches. Anteprenotum thin with a small dorsal emargination. Acrostichals 12 arranged in pairs from tip of mesonotum, dorsocentrals 10 in a row, humerals 0, prealars 2—3 (3). Scutellum with 10 setae arranged irregularly, postscutellum dark brown and bare.

Wing (fig. 7b): Pale with veins yellow and conspicuous. Brachiolum with 2 setae. R with 14, R_1 with 18 and R_{4+5} with 30—32 setae; R_{2+3} meets C almost near the middle, the distance being 0.11 mm from R_1 ; ending of R_{4+5} and C acute; r—



Figs. 7a—d. *Polypedilum insolitum* n.sp. ϕ : a, thorax; b, wing; c, tibial ends of fore, mid and hind legs with fore and mid femora and tibia; d, hypopygium.

m distinct and proximal to f—Cu; An ends before f—Cu. Wing with several irregular grey spots distributed as follows: (i) 1 pair broad, unequal spots or bands over the basal and middle of cells R_{4+5} and M_{1+2} with its vicinities, (ii) 1 each near the apical margin of cell R_{4+5} and cell M_{1+2} , (iii) 3 unequal spots in cell M_{3+4} , (iv) 1 large and 1 small linear spot placed one above the other at the distal end of cell An. In addition to the above, linear dark streaks are observed along the distal part of M_{1+2} and in cell An. Sensory organ 1 on r—m. Squama bare. Haltere bare and yellow in both stem and knob. Wing length 1.48 (1.48—1.50, $n=2$) mm, breadth 0.48 ($n=2$) mm. CR 0.95, VR 1.20.

Legs (fig. 7c): Brown to dark brown in colour. Fore femur and tibia brown with a distal broad dark brown band, femur and tibia of mid and hind legs with a broad proximal and small preapical dark brown band. Fore tibial scale with a sharp pointed spur 0.045 mm long. Spur of mid tibia bent at the apex, ratio of length of spur to the apical diameter of mid tibia 4:4; spur of hind tibia 0.09 mm long, ratio

of length of spur to the apical diameter of hind tibia 6:4. Tarsomeres of all legs brown to dark brown. Pulvilli split longitudinally. LR 1.48 in fore leg, LR 0.77 in mid and LR 0.90 in hind legs. Abdomen: Brown with alternate dark brown bands on terga I to VII and with uniformly distributed long setae. Segment VIII deeply constricted at the base.

Hypopygium (fig. 7d): Anal point small, 0.025 mm long and rod-like and narrowed distad. Gonocoxite with 16—18 (18) long setae; gonostylus small, little expanded and abruptly attenuated, with 5 small setae along its inner apical margin. Appendage 1 short, base broad, distal part slightly bent and bare; appendage 2 elongated, dorsoventrally compressed, reaching almost the middle of gonostylus, appendage 2 also without incurved setae but 1—2 setae near its blunt apex. Laterotergite with 6—7 setae, transverse sternapodeme 0.22 mm long, lateral sternapodeme 0.09 mm long, coxapodeme 0.06 mm long, phallapodeme 0.07 mm. HR 1.2, HV 3.27.

Female: Unknown.

***Polypedilum lineatum* n.sp.**

(figs. 8a—e)

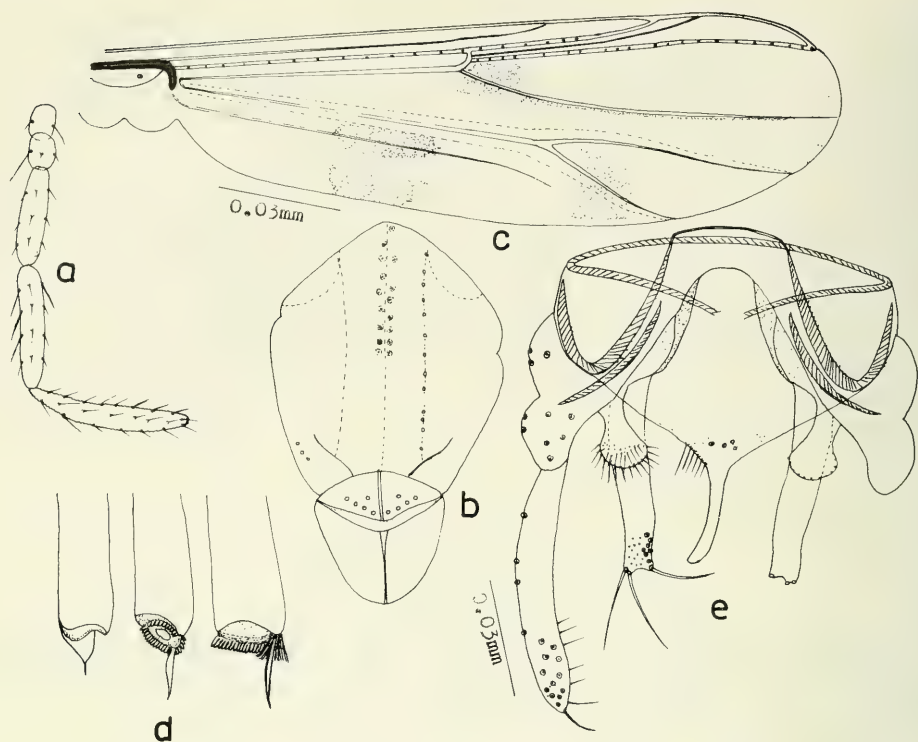
Material: Holotype ♂ (Type no. 83, B.U. Ent.), India, West Bengal, Raniganj, 28.x.1977, D. K. Guha. Paratypes: 8 ♀, Burdwan, 28—30.x.1977, A. Chatterjee; 4 ♂, Siliguri, 21—22.iv.1979, S. K. Das Gupta; 3 ♂, Triveni, 4.iv.1979, S. Sarkar.

Remarks: The above species is named *Polypedilum lineatum* in view of its conspicuous linear dark spots running parallel to M_{1+2} . It seems close to *Polypedilum tonnoiri* Freeman (1961) from Australia in regard to the wing and the male hypopygium. The characters (i) chaetotaxy of thorax, nature of spots on the wing, (ii) infuscation on the apical margin of wing, (iii) dark streak below M_{1+2} , (iv) bands on the mid and hind femur with its chaetotaxy, (v) size and structure of anal point and (vi) appendages 1 + 2, and certain other characters clearly justify its treatment as a distinct species. It should be noted also that the flagellomeres of male antenna number thirteen instead of twelve as in other species.

Male: Body length 1.81 mm.

Head: Dark brown in colour. Vertex dark brown with 11 (postocular 2, outer verticals 8, inner vertical 1) setae. Corona with 1 seta. Clypeus with 16 setae, clypeal ratio 1. Maxillary palp (fig. 8a) brown, palpomere III with a preapical pit bearing sensilla, palpomere V with 1 straight apical seta, length ratio of palpomeres I—V 7:6:20:24:32, L/W ratio 4. Eyes bare, semicircular, little extended dorsally, extension being 0.09 mm long. Frontal tubercles absent. Antenna dark brown, setaceous, setae longer at proximal flagellomeres and shorter distad, length ratio of flagellomeres I—XIII 5:6:8:8:8:8:8:9:9:9:9:9:75; AR 0.71. Pedicel ratio 1.03. CA 0.65, CP 1.2.

Thorax (fig. 8b): Yellow to light brown with a median and two lateral brownish bands on mesonotum. Anteprenotum dark, very thin without dorsal emargina-



Figs. 8a—e. *Polypedilum lineatum* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, tibial ends of fore, mid and hind legs; e, hypopygium.

tion. Acrostichals 16 in two rows, dorsocentrals 14 in one row, humeral 0, prealars 3. Scutellum with 10 setae arranged in oblique row, postscutellum dark brown and bare.

Wing (fig. 8c): Cloudy. Brachiolum with 1 seta. R with 13, R_1 with 6 setae at the basal half and R_{4+5} with 21 setae; R_{2+3} meets C close to R_1 , distance being 0.05 mm from R_1 ; ending of R_{4+5} and C acute; r—m slightly proximal to f—Cu; An ends below f—Cu. Wing with faint grey irregular spots distributed as follows: (i) one at the base of cell R_{4+5} near r—m, (ii) one near f—Cu in cell M_{3+4} , (iii) one linear dark streak running parallel to M_{1+2} , (iv) one broad interrupted spot at the middle and another at the apex of cell An, in some cases the apical margin of cell R_{4+5} and M_{1+2} appear to be infuscated. Sensory organ 1 at the base of R_1 and R_{4+5} . Squama with 3 setae. Haltere brown, and bare. Wing length 0.97 (0.94—0.99, $n=6$) mm, breadth 0.34 (0.33—0.35, $n=6$) mm. CR 0.97, VR 1.48.

Legs (fig. 8d): Yellow to light brown with numerous long weak setae. Femur of mid and hind legs with a middle apical/subapical light greyish band. Fore tibial scale triangular and pointed bearing 1 long seta. Spur of mid tibia slightly curved, 0.04 mm long, ratio of length of spur to the apical diameter of mid tibia 11:10; spur of hind tibia equal to that of mid tibia, ratio of length of spur to the apical diameter of hind tibia 11:12. Pulvilli longitudinally split with a long setaceous empodium.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	31	17	27	12	8	5	4	1.59	—
Mid	35	27	15	10	7	5	4	0.56	—
Hind	35	31	19	13	9	6	5	0.61	1.46

Abdomen: Light brown with a longitudinal band at the middle of terga. Segment VIII constricted at the base.

Hypopygium (fig. 8e): Anal point quite long (0.03 mm) long, little bent and dilated at the apex, anal point with 10—12 setae at each basal margin. Gonocoxite small with 4—6 setae; gonostylus very long, little bowed with 15—17 (17) small setae at its inner apical margin, gonostylus with 8—10 long setae. Appendage 1 well developed, wider at the apex, with numerous small setae; appendage 2 long, slightly bent near base, with 2 long and 8 incurved setae. Transverse sternapodeme 0.11 mm long, lateral sternapodeme 0.05 mm long, coxapodeme 0.03 mm long, phallapodeme 0.04 mm long. HR 0.68, HV 1.63.

Female: Unknown.

***Polypedilum lucidum* n.sp.**

(figs. 9a—e)

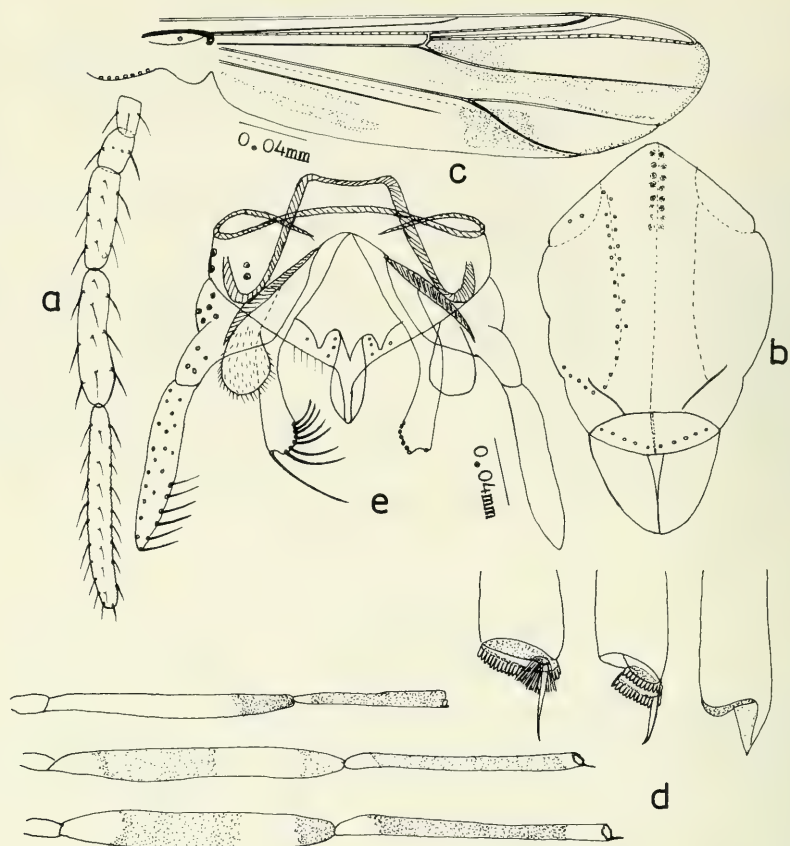
Material: Holotype ♂ (Type no. 84, B.U. Ent.), India, West Bengal, Burdwan, 12.iii.1978, S.K. Nandi. Paratypes: 10 ♂, data same as holotype; 4 ♂, Calcutta (reared in the laboratory), D. K. Guha; 2 ♀, Panagar, 7.iv.1977, K. Sinha.

Remarks: The present species is named as *Polypedilum lucidum* because of the presence of pale infuscations or spots on the wing. It shows similarities in relation to wing with *Polypedilum longicrus* Kieffer (1911) from Africa. Similarly, it shows resemblances with *P. numerus* n.sp. described in this paper and *P. swlovatum* Johannsen (1932) in the male hypopygium. However, *P. lucidum* can be identified as a separate species by the colour pattern of wing and haltere bands on legs, structure of fore tibial scale and the male hypopygium.

Male: Body length 2.29 (2.22—2.40, n=8) mm.

Head: Brown to dark brown in colour. Vertex brown with 9 (postocular 1, outer verticals 7, inner vertical 1) setae. Corona without setae. Clypeus with 22—24 (24) setae, clypeal ratio 1.15. Maxillary palp (fig. 9a) pale yellow to brown; palpomere III with a preapical pit bearing 2 sensilla; palpomere V pale with 1 long apical seta; length ratio of palpomeres I—V 7:9:21:27:42, L/W ratio 3.5. Eyes bare, ovoid, well separated, extended dorsally, extension being 0.14 mm long. Frontal tubercle absent. Antenna dark brown, densely setaceous, setae longer at base and gradually become shorter distad, apex of flagellomere XII without long seta; length ratio of flagellomeres I—XII 2:2:2:2:2:2:2:2:2:2:2:32; AR 1.4. Pedicel ratio 1.25. CA 0.52, CP 1.2.

Thorax (fig. 9b): Brown in colour. Anteprenotum very thin, collar-like without V-shaped emargination. Acrostichals 16 in pairs, dorsocentrals 23,



Figs. 9a—e. *Polypedilum lucidum* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, fore, mid and hind legs with their tibial ends; e, hypopygium.

humeralis 2, prealaris 5. Scutellum with 10 setae in a simple transverse row, postscutellum dark brown and bare.

Wing (fig. 9c): Cloudy with veins pale. Brachiolium with 1 seta. R with 24, R_1 with 15 and R_{4+5} with 28 setae; R_{2+3} meets C very close to R_1 being 0.05 mm from R_1 ; ending of R_{4+5} and C subacute; r—m distinct and proximal to f—Cu; An ends a little proximal to f—Cu. Wing with infuscations often in the form of spots or bands distributed as follows: (i) one spot at the base of cell R_{4+5} , (ii) one linear dark streak parallel to M_{1+2} in cell M_{1+2} , (iii) one spot at the base of cell M_{3+4} near f—Cu and (iv) two linear spots at the proximal half of cell An, and one spot at the apex of the cell. Squama with 7 setae. Haltere with stem light brown and knob dark brown and bare. Wing length 1.36 (1.29—1.48, $n=8$) mm, breadth 0.44 (0.39—0.48, $n=8$) mm. CR 0.97, VR 1.3.

Legs (fig. 9d): Brown to dark brown in colour. Fore femur with an apical dark brown band, femur of mid and hind legs each with a broad median and a small apical dark brown band; tibia of both mid and hind legs with a basal and apical pale band. Fore tibial scale triangular with a short pointed tip. Spur of mid tibia 0.04 mm long, ratio of length of spur to the apical diameter of mid tibia 13:12;

spur of hind tibia slightly bent at the apex, 0.05 mm long, ratio of length of spur to the apical diameter of hind tibia 16:14. Tarsomeres slightly pale. Pulvilli lobe-like, split at the middle; with a long empodium equal to the claws.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	17	11	21	12	9	7	4	1.91	—
Mid	19	16	10	5	4	3	2	0.62	—
Hind	19	18	13	8	6	4	3	0.72	1.62

Abdomen: Light brown in colour, terga uniformly setaceous, setae on lateral side arranged in rows. Segment VIII broadly constricted at its base.

Hypopygium (fig. 9e): Anal point with 3 setae at each basal margin and a fair number of setae at its base. Gonocoxite well developed with 12—15 long setae; gonostylus long, narrowed down with 5 setae at its inner apical margin, gonostylus with 17—19 setae over it. Appendage 1 clublike bearing numerous small setae; appendage 2 long, bowed, apex wide, bearing 8 long incurved setae. Transverse sternapodeme 0.19 mm long, lateral sternapodeme 0.09 mm long, coxapodeme 0.03 mm long, phallapodeme 0.07 mm long. HR 0.8, HV 1.55.

Female: Unknown.

***Polypedilum nudiceps* n.sp.**

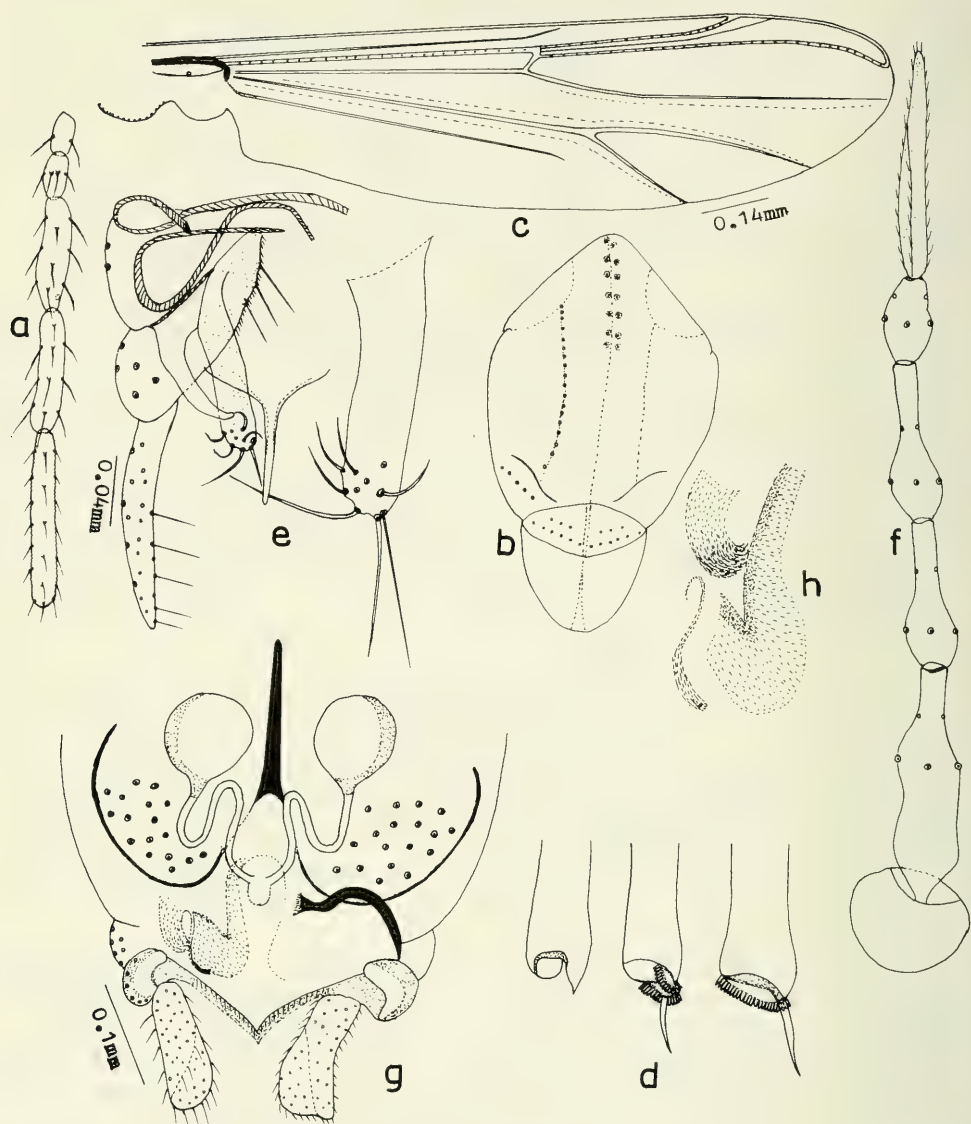
(figs. 10a—h)

Material: Holotype ♂ (Type no. 85, B.U. Ent.), India, West Bengal, Darjeeling, 5.ix.1977, S. K. Das Gupta. Allotype ♀, data same as holotype. Paratypes: 50 ♂, 36 ♀, Darjeeling, July-Oct., 1977, S. K. Das Gupta; 7 ♂, 3 ♀, Ghum, June, 1973, D. C. Sinharay; 5 ♂, Jorbangla, Sept., 1978, P. Chaudhuri; 11 ♂, 10 ♀, 12.ix.1978, A. Roy; 2 ♂, 1 ♀, Kurseong, Sept., 1978, S. Pal; 9 ♂, 3 ♀, Lebong, Sept., 1978, P. K. Chaudhuri.

Remarks: The above species is named *Polypedilum nudiceps* in view of bare appendage 1 of the male hypopygium. It comes close to *Polypedilum bipustulatum* Freeman (1958) from Africa in some morphological features specially in relation to the male hypopygium but the characters like, (i) colour of the specimens including haltere, (ii) absence of stripes in the mesonotum, (iii) haltere without any setae, (iv) shape of appendage 1, (v) appendage 1 without seta, (vi) appendage 2 with 2 long apical setae, (vii) long anal point, amply justify its identity as a distinct species.

Male: Body length 2.77 (2.59—2.96, n=15) mm.

Head: Brown to dark brown in colour. Vertex brown with 12 (postocular 1, outer verticals 7, inner verticals 4) setae. Corona without setae. Clypeus with 18—20(20) long setae, clypeal ratio 1.0. Maxillary palp (fig. 10a) yellow, palpomere II dark brown, length ratio of palpomeres I—V 9:10:30:35:53; L/W ratio 5.0. Eyes bare, hemispherical, slightly extended dorsally, extension 0.11 mm long. Antenna yellow to light brown in colour, flagellomere XII longest, pear-shaped and densely setaceous, setae longer at the base and gradually



Figs. 10a—h. *Polypedilum nudiceps* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, tibial ends of fore, mid and hind legs; e, hypopygium. ♀: f, antenna, g—h, genitalia.

narrowed distad, length ratio of flagellomers I—XII 15:8:10:10:10:11:11:11:11:11:11:81; AR 0.62. Pedicel ratio 1.25. CA 0.6, CP 0.85

Thorax (fig. 10b): Deep yellow to brown in colour. Antepronotum very thin without any V-shaped emargination. Acrostichals 14—16 in pairs, dorsocentrals 18, prealars 5, humeral 0—1. Scutellum with 12 long and 6 small setae arranged in two oblique rows, postscutellum light brown and bare.

Wing (fig. 10c); Microtrichia dense and the veins brown in colour. Brachiolum

with 1 seta. R with 26, R_1 with 18, R_{4+5} with 52 setae; R_{2+3} meets C very close to R_1 being 0.02 mm away from R_1 ; ending of R_{4+5} and C blunt; r—m oblique and proximal to f—Cu; An ends a little proximal to f—Cu. Squama with 15 setae. Haltere with yellow stem and knob and bare. Wing length 1.85 (1.66—1.96, $n=15$) mm, breadth 0.55 (0.48—0.62, $n=15$) mm. CR 0.52, VR 1.3.

Legs (fig. 10d): Yellow in colour. Fore tibial scale abruptly pointed with 3—4 setae. Spur of mid tibia bent at the apex, 0.064 mm long, ratio of length of spur to the apical diameter of mid tibia 15:12; spur of hind tibia also bent at the apex, 0.068 mm long, ratio of length of spur to the apical diameter of hind tibia 16:13. Pulvilli split longitudinally; empodium as long as claws.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	22	13	28	18	11	9	4	2.16	—
Mid	26	21	11	7	6	4	3	0.52	—
Hind	28	23	17	11	9	6	3	0.74	1.54

Abdomen: Yellow to light brown in colour. Terga uniformly setaceous and with greyish broad bands. Segment VIII constricted basally.

Hypopygium (fig. 10e): Anal point long (0.062 mm), pointed with 7—8(8) small setae at each basal margin. Gonocoxite short with 6 setae; gonostylus long, little bent inward, apex narrowed down and tip in most cases abruptly pointed with a long seta; in other cases, gonostylus straight, widened with little attenuation at tip, gonostylus with 15—16 setae over it and 6—7 setae along its inner margin. Appendage 1 bare, broad at base, narrowed down to apex and gently bent inward, often bearing 2 long straight and 6—7 incurved setae. Laterotergite with 6—7 long setae, transverse sternapodeme 0.086 mm long, coxapodeme 0.034 mm long, phallapodeme 0.077 mm long. HR 0.4, HV 1.83.

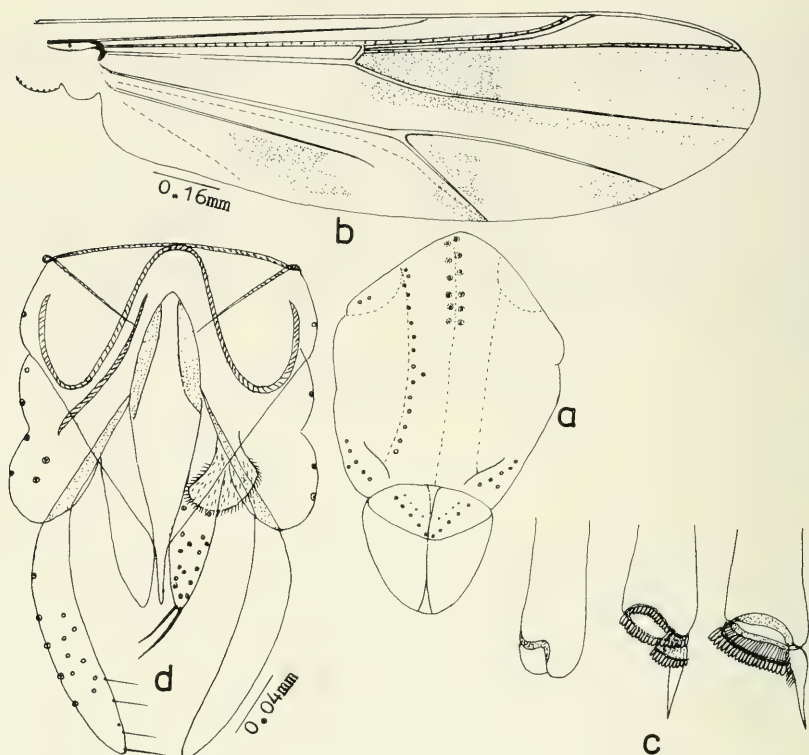
Female: Body length 2.40 (2.12—2.70, $n=15$) mm.

Similar to male with usual sex differences. Maxillary palp light brown, length ratio of palpomeres I—V 11:12:36:43:68, L/W ratio 4.5. Antenna (fig. 10f) light brown, length ratio of flagellomeres I—V 30:20:23:12:30. Genitalia (figs. 10g—h): Notum 0.11 mm long. Coxosternapodeme well developed, with a notch and two bends. Gonocoxapodeme VIII joined indistinctly at the middle. Gonapophysis VIII with a large dorsomesal lobe and brush-like ventrolateral lobe. Apodeme lobe very weak. Tergum IX as usual. Tergum X with 6—7 setae on each side. Gonocoxite IX with 6—8 setae. Postgenital plate protruded and pointed at the apex. Cerci normal. Labia with dense microtrichia. Seminal capsules oval, 0.055 mm by 0.051 mm long with a short neck; ducts of seminal capsules mostly with two bends.

***Polypedilum numerus* n.sp.**

(figs. 11a—d)

Material: Holotype ♂ (Type no. 86, B.U. Ent.), India, West Bengal, Darjeeling, 27.x.1977, P. Chaudhuri. Paratypes: 3 ♀, data same as holotype; 3 ♂,



Figs. 11a—d. *Polypedilum numerus* n.sp. ♂: a, thorax; b, wing; c, tibial ends of fore, mid and hind legs; d, hypopygium.

Jorbangla, 3.xi.1978, P. Chaudhuri; 1 ♂, Kurseong, 22.x.1977, S. K. Das Gupta.

Remarks: The species is named as *Polypedilum numerus* in view of the finger-like appendage 2 of the male hypopygium. It comes close to *Polypedilum flagellatum* n.sp. described in this paper and *P. watsoni* Freeman (1961) from Australia in some aspects of wing and the male hypopygium. The characters like, (i) setae in corona, (ii) presence of prescutellar setae, (iii) number and nature of spots or bands on the wing, (iv) bands on the abdominal terga, (v) structure and size of anal point and (vi) male hypopygium having short gonocoxite, long gonostylus, club-shaped appendage 1 with numerous setae and finger-like long appendage 2 with incurved setae, differentiate it as a distinct and valid species in the genus *Polypedilum*. It will be worth mentioning in this connection that, since the antenna was not available in any of the slide-mounts of this species examined, it has not been possible in this study to present any information on it.

Male: Body length 2.73 mm.

Head: Yellow to light brown. Vertex with 12 (outer verticals 7, inner verticals 5) setae. Corona with 14 setae, clypeal ratio 1.09. Eyes bare, wider, extended dorsally, extension being 0.11 mm long. Frontal tubercles absent. Maxillary palp

pale, palpomere III with a preapical pit (sensilla not seen), length ratio of palpomeres I—V 6:5:15:20:28, L/W ratio 4.5. Antenna broken in all specimens. Pedicel ratio 1.25.

Thorax (fig. 11a): Yellow to light brown in colour. Antepronotum thin, without dorsal emargination. Acrostichals 12 in pairs, dorsocentrals 16, humerals 3, prealars 6. Scutellum with 10 large and 8 small setae arranged in two rows, postscutellum light brown.

Wing (fig. 11b): Pale brownish in colour. Brachiolum with 1 seta. R with 24, R_1 with 17 and R_{4+5} with 31 setae; R_{2+3} meets C close to R_1 , distance being 0.05 mm from R_1 ; ending of R_{4+5} and C acute; $r-m$ proximal to $f-Cu$; An ends a little proximal to $f-Cu$. Wing with light irregular grey spots or bands distributed as follows: (i) two broad bands at the proximal and distal part of cell R_{4+5} , (ii) two in cell M_{3+4} , one being near $f-Cu$ and another small one below the apex of M_{3+4} , (iii) two in cell An, one broad at the middle and another below apex of Cu_1 , (iv) one linear grey streak parallel to M_{1+2} in cell M_{1+2} . Squama with 8 setae. Haltere yellow and bare. Wing length 1.29, breadth 0.44 mm. CR 0.98, VR 1.23.

Legs (fig. 11c): Yellow in colour. Femur slightly dark proximally. Fore tibial scale blunt with 1 long seta. Spur of mid tibia straight, 0.055 mm long, ratio of length of spur to the apical diameter of mid tibia 15:13; spur of hind tibia slightly bent apically, 0.059 mm long, ratio of length of spur to the apical diameter of hind tibia 16:14. Pulvilli split in the middle; empodium slightly longer than pulvilli.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	43	29	39	14	11	8	4	1.38	—
Mid	48	40	21	8	7	5	2	0.52	—
Hind	50	44	24	10	8	5	3	0.60	2.4

Abdomen: Terga I—III with brown bands and uniformly setaceous. Segment VIII moderately constricted at the base.

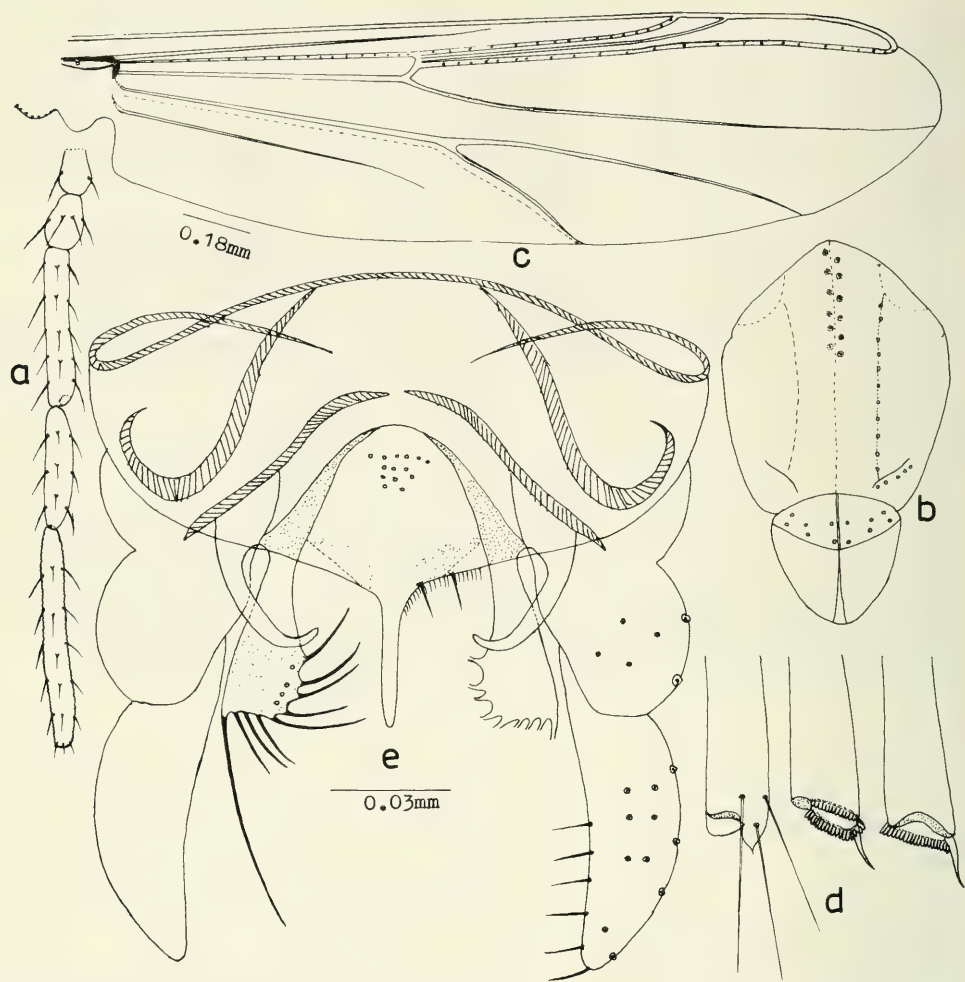
Hypopygium (fig. 11d): Anal point short, 0.033 mm in length, with a few setae at its base. Gonocoxite short, bearing 2—4(4) long setae and numerous small setae at its inner margin; gonostylus long, little bowed, with 4 setae at its inner apical margin, gonostylus with 8—10(10) setae over it. Appendage 1 broad, roughly club-shaped with numerous small setae; appendage 2 elongated, finger-like with 15—16(15) long incurved setae. Laterotergite with 2 long setae, transverse sternapodeme 0.09 mm long, coxapodeme 0.03 mm long, phallapodeme 0.07 mm long. HR 0.46, HV 2.02.

Female: Unknown.

***Polypedilum pseudoflagellatum* n.sp.**

(figs. 12a—e)

Material: Holotype ♂ (Type no. 87, B. U. Ent.), India, West Bengal, Durgapur, 5.xi.1976, R. K. Debnath. Paratypes: 2 ♂, Batanagar, 12.v.1975, S. K. Das Gupta; 2 ♂, Burdwan, 2—3.vii.1977, A. Chatterjee; 1 ♂, Kharagpur,



Figs. 12 a—e. *Polypedilum pseudoflagellatum* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, tibial ends of fore, mid and hind legs; e, hypopygium.

14.x.1978, P. K. Chaudhuri; 2 ♂, Raniganj, 28.vii.1977, D. K. Guha.

Remarks: This species is named *Polypedilum pseudoflagellatum* because of its close similarities with *Polypedilum flagellatum* n.sp. described in this paper. Although this species resembles *P. flagellatum* in some features, it is held as a distinct and valid species on the basis of the following:

P. flagellatum n.sp.

1. Corona with 4 setae
2. Clypeus with 21 setae
3. Wing with spots
4. Fore tibial scale elongated with blunt apex
5. HR 1.14

P. pseudoflagellatum n.sp.

1. Corona without setae
2. Clypeus with 13 setae
3. Wing without spots
4. Fore tibial scale triangular with pointed apex
5. HR 0.62

Male: Body length 2.7 mm.

Head: Brown in colour. Vertex light brown with 9 setae (postocular 0, outer verticals 6, inner verticals 3). Corona without setae. Clypeus with 13 setae, clypeal ratio 1.22. Maxillary palp (fig. 12a) brown, palpomere III with an rounded apical pit bearing bearing 1—2 sensilla, length ratio of palpomeres I—V 5:8:27:24:46, L/W ratio 4.5. Eyes bare, comma-shaped, extended dorsally, extension pointed and being 0.37 mm long. Frontal tubercles absent. Antenna dark brown, densely pubescent, setae longer at proximal flagellomeres and gradually narrowed distad, length ratio of flagellomeres I—XII 2:4:2:2:2:2:2:2:1:1:1:36, AR 1.7. Pedicel ratio 0.84. CA 0.58, CP 1.25.

Thorax (fig. 12b): Yellowish brown in colour. Anteprenotum very thin without V-shaped emargination. Acrostichals 10—12(10) in pairs, dorsocentrals 12 in a row, humerals 2, prealars 5. Scutellum with 10—12 setae arranged irregularly, postscutellum dark brown to black and bare.

Wing (fig. 12c): Whitish without any clouds in most cases. Veins yellow. Brachiolum with 1 seta. R with 19, R_1 with 16 and R_{4+5} with 22—24(24) setae; R_{2+3} meets C very close to R_1 , distance being 0.05 mm from R_1 ; ending of R_{4+5} and C acute; r—m distinct and proximal to f—Cu; An ending little below f—Cu. Squama with 7 setae. Haltere bare with light brown stem and knob. Wing length 1.36 (1.34—1.38, $n=5$) mm, breadth 0.44 (0.42—0.45, $n=5$) mm. CR 0.94, VR 1.21.

Legs (fig. 12d): Yellow in colour. Fore tibial scale triangular with a very short and abrupt point bearing 3 long setae at the base. Spur of mid tibia bent, 0.03 mm long, ratio of length of spur to the apical diameter of mid tibia 10:13; spur of hind tibia also bent, 0.04 mm long, ratio of length of spur to the apical diameter of hind tibia 13:13. Pulvilli small and bilobed; with a small setaceous empodium.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	17	11	20	12	9	7	4	1.82	—
Mid	19	15	9	5	4	3	2	0.6	—
Hind	19	17	11	6	5	4	2	0.65	1.83

Abdomen: Dark brown in colour, terga with scattered setae, lateral setae arranged in longitudinal row. Segment VIII constricted at base but less than in *Polypedilum flagellatum* n.sp.

Hypopygium (fig. 12e): Anal point 0.51 mm long, apex subacute, bearing a number of small setae at each basal margin. Gonocoxite short with 6—8(8) setae; gonostylus moderately developed, slightly bowed and with 6 small setae at its inner apical margin, gonostylus with 12 long setae over it. Appendage 1 well developed, distal part bent inward and without seta; appendage 2 well developed, narrow at the base, pointed at the apex, bearing 12—14(12) long curved setae of which outermost longer than that *Polyepedilum flagellatum* n.sp. described in this paper. Laterotergite with 6—7(7) setae, transverse sternapodeme 0.2 mm long, lateral sternapodeme 0.09 mm long, coxapodeme 0.03 mm long, phallapodeme 0.06 mm long. HR 0.62, HV 2.43.

Female: Unknown.

***Polypedilum rufomarginalis* n.sp.**
(figs. 13a—f)

Material: Holotype ♂ (Type no. 88, B.U. Ent.), India, West Bengal, Burdwan, 4.ix.1878, A. Chatterjee. Allotype ♀, data same as holotype. Paratypes: 8 ♂, 4 ♀, Burdwan, 3—4.ix.1977, 2.iii.1978, A. Chatterjee; 3 ♂, Berhampur, 22.ix.1976, P. K. Chaudhuri; 4 ♂, 1 ♀, Malda, 15.viii.1974, S. Chatterjee; 3 ♂, 1 ♀, Raniganj, 11—12.iii.1978, D. C. Sinharay; 2 ♂, Tribeni, 7.iii.1975, S. Das.

Remarks: In view of the beautifully red coloured margin of the mesonotum, this species is named *Polypedilum rufomarginalis*. It appears to bear some similarities in colour pattern of the wing to *Polypedilum nubifer* (Skuse) from Australia and in the male hypopygium to *P. alticola* Kieffer (1913) from Africa and *Chironomus nitidus* Kieffer (1913) from Calcutta, India, but the colour pattern of the mesonotum, wing, leg, tarsomere V, basal constriction of the abdominal segment VIII and the shape of the male hypopygium altogether support its distinctiveness from the above-mentioned species.

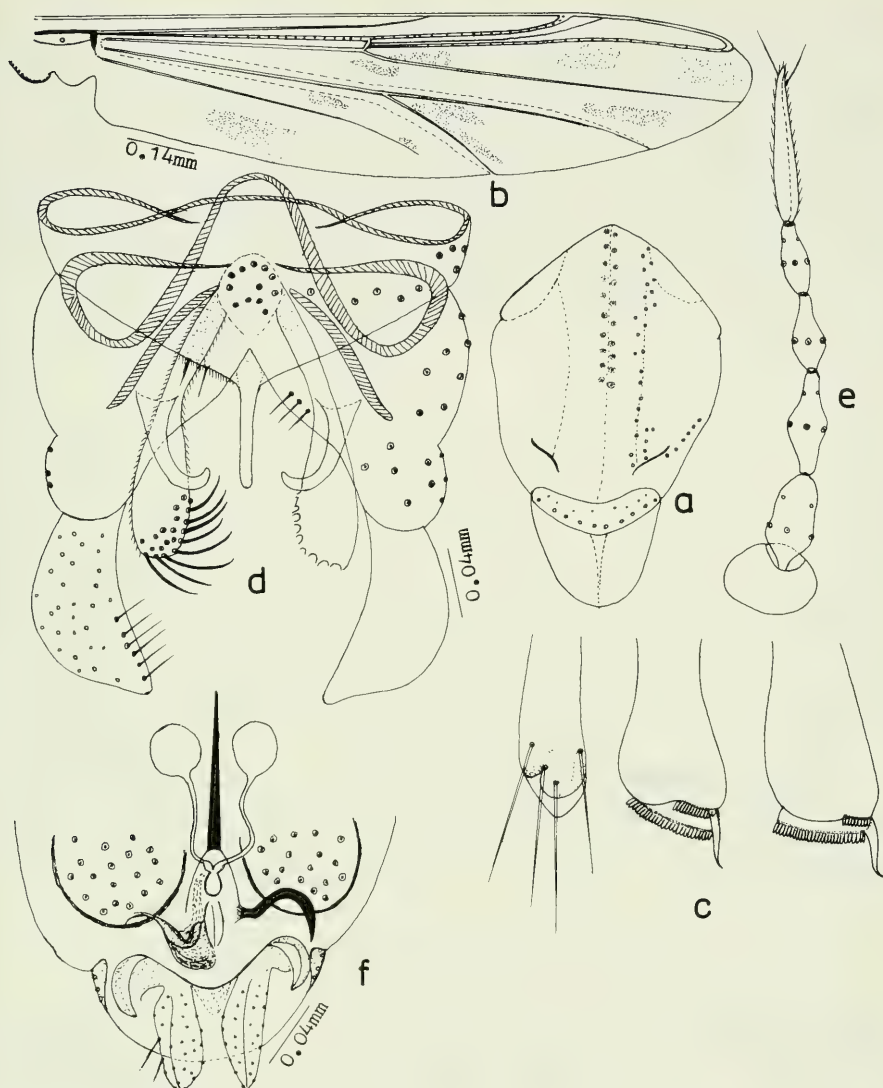
Male: Body length 4.25 (4.14—4.4, n=10) mm.

Head: Reddish brown in colour. Vertex red with 15 (postocular 3, outer verticals 8, inner verticals 4) setae. Corona without setae. Clypeal with 22 long setae, clypeal ratio 1.66. Maxillary palp dark brown, palpomere III quite long with a preapical pit bearing 3 cilia-like sensilla; length ratio of palpomeres I—V 9:12:33:35:45, L/W ratio 3. Eyes bare, crescentic, extended dorsally, extension 0.14 mm long. Frontal tubercles absent. Antenna dark brown, densely setaceous, setae longer at proximal flagellomeres and gradually becomes shorter distad, flagellomere XII devoid of seta; length ratio of flagellomeres I—XII 2:2:2:2:1:1:1:1:1:1:1:53, AR 3.47. Pedicel ratio 1. CA 0.63, CP 1.2.

Thorax (fig. 13a): Brown to dark brown with red patches, margin chocolate red. Anteprenotum dark red, thin, without V-shaped emargination. Acrostichals 18—20(20) in pair from the tip of mesonotum, dorsocentrals 28, humeral 1, prealars 6. Scutellum with 18—20 setae, postscutellum dark brown with a median suture and bare.

Wing (fig. 13b): Pale yellowish in colour and the veins conspicuous. Brachio-lum with 1 seta. R with 25, R₁ with 21 and R₄₊₅ with 24 setae; R₂₊₃ meets C very close to R₁, distance being 0.09 mm from R₁; ending of R₄₊₅ and C subacute; r—m distinct and proximal to f—Cu; An ending below f—Cu. Wing with nine grey irregular spots distributed as follows: (i) cell R₄₊₅ with three spots placed at the base, middle and near the apex, (ii) cell M₁₊₂ with two spots placed near the base of M₁₊₂ and behind the apex, (iii) cell M₃₊₄ with one spot near f—Cu and continuous along Cu₁ as a streak, (iv) cell An with one broad at the middle, one small behind f—Cu and another at the end of An. Sensory organ 1 on r—m. Squama with 15 setae. Haltere light brown at stem and dark brown or black at the knob. Wing length 2.07 (1.99—2.14, n=10) mm, breadth 0.55 (0.52—0.59, n=10) mm. CR 0.96, VR 1.08.

Legs (fig. 13c): Yellow to brown in colour. Femur slightly dark, fore tibia pale near the apex. Fore tibial scale blunt with 4—5 long setae. Spur of mid tibia bent being 0.04 mm long, ratio of length of spur to the apical diameter of mid tibia



Figs. 13a—f. *Polypedilum rufomarginalis* n.sp. ♂: a, thorax; b, wing; c, tibial ends of fore, mid and hind legs; d, hypopygium, ♀; e, antenna, f, genitalia.

12:19; spur of hind tibia also bent, 0.05 mm long, ratio of length of spur to the apical diameter of hind tibia 15:20. Tarsomere IV brown and tarsomere V dark in all legs. Pulvilli narrow and split; a short setaceous empodium, shorter than claws.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	29	18	26	14	12	9	4	1.44	—
Mid	29	23	14	8	6	4	2	0.60	—
Hind	28	27	19	10	9	5	3	0.70	1.9

Abdomen: Dark brown in colour. Tergum 1 with a broad median depression; setae on terga long and arranged in irregular rows. Segment VIII constricted like a triangle having a very narrow base.

Hypopygium (fig. 13d): Anal point 0.07 mm long, tip blunt, base broader with 8—10(10) small setae. Gonocoxite well developed, long, with 18—20(18) long setae; gonostylus short, stout, apex a little narrowed, bearing 4—6(4) small setae at its inner apical margin. Appendage 1 hockey-stick-shaped; appendage 2 narrow at base and gradually becoming wider towards apex, with 18—20 long incurved setae. Laterotergite with 3—4(3) setae, transverse sternapodeme 0.28 mm long, lateral sternapodeme 0.17 mm long, coxapodeme 0.08 mm long, phallapodeme 0.13 mm long. HR 1.17, HV 3.80.

Female: Body length 3.6 mm.

Similar to male with usual sex differences. Maxillary palp pale to dark brown. Palpomere 1 pale, others dark brown, length ratio of palpomeres I—V 10:9:28:25:45, L/W ratio 3.1. Antenna (fig. 13e) yellow to dark brown, flagellomeres I—V dark brown and narrowed with 2 subapical setae, length ratio of flagellomeres I—V 7:6:5:5:9, AR 0.39. Colour and spots of wings similar to that of male. Wing length 1.96 (1.92—1.96, $n=5$) mm, breadth 0.66 (0.65—0.68, $n=5$) mm. Genitalia (fig. 13f): Notum 0.16 mm long. Gonocoxapodeme VIII caudally rounded and widely separated at the middle. Coxosternapodeme with a small and broad bend. Gonapophysis VIII with a tongue-like dorsomesal lobe and a small blunt brush-like ventrolateral lobe. Apodeme lobe moderate. Gonocoxite IX with 3—4 long setae. Tergum IX with 8—10(8) setae on each side. Tergum X normal. Postgenital plate as small protuberance. Cerci elongated. Labia narrow, with microtrichia. Seminal capsules (fig. 13f) equal, oval, with small neck, measuring 0.05 mm by 0.03 mm; ducts of seminal capsules straight or with one bent and an ampulla before opening in common.

***Polypedilum tripunctum* n.sp.**

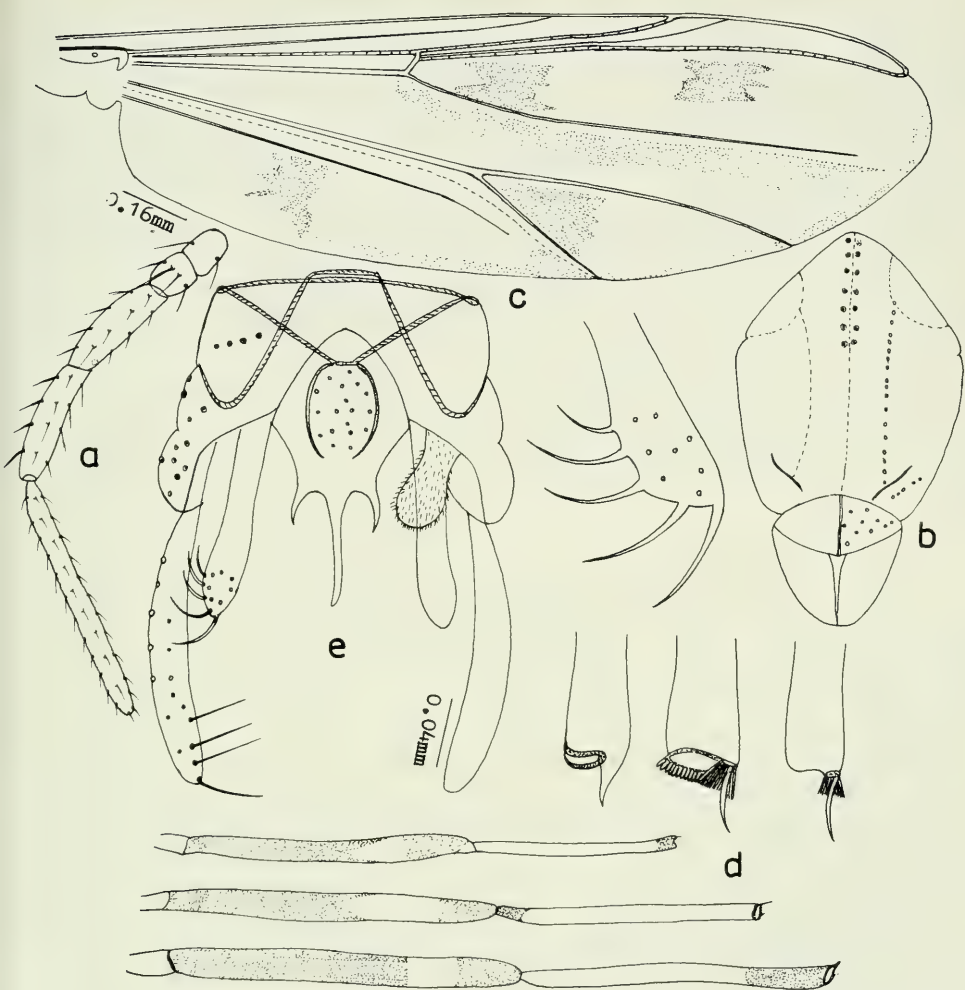
(figs. 14a—e)

Material: Holotype ♂ (Type no. 89, B.U. Ent.), India, West Bengal, Darjeeling, 25.x.1970, S. K. Das Gupta. Paratypes: 4 ♂, Darjeeling, 2—3.ix.1973, P. K. Chaudhuri; 1 ♂, Tindharia, 17.ix.1974, T. Sharma.

Remarks: The present species is named *Polypedilum tripunctum* in view of its triradiate structure of anal point of the male hypopygium. It resembles *Polypedilum aegyptum* Kieffer (1925), *P. pruina* Freeman (1958) and *P. tridens* Freeman (1958) in certain features of the male hypopygium and *P. tropicum* Kieffer (1913) in respect of wing and male hypopygium, but its separate entity as a valid species can be justified by means of the following features: (i) spots on the wing, (ii) spur of fore tibia, (iii) dark bands on legs, (iv) structure of the appendages 1 and 2 with its chaetotaxy and (v) shape of anal point.

Male: Body length 2.75 (2.53—3.0, $n=5$) mm.

Head: Brown to dark brown. Vertex brown with 12 (postocular 1, outer verticals 8, inner verticals 3) setae. Corona without setae. Clypeus with 18—20



Figs. 14a—e. *Polypedilum tripunctum* n.sp. ♂: a, maxillary palp; b, thorax; c, wing; d, femora and tibia of fore, mid and hind legs with their tibial ends; e, hypopygium.

(18) long setae, clypeal ratio 0.83. Maxillary palp (fig. 14a) light brown, palpomere V brown, length ratio of palpomeres I—V 7:7:20:23:42, L/W ratio 3.3. Eyes bare, hemispherical, extended dorsally, extension being 0.15 mm long. Frontal tubercles absent. Antenna brown to pale brown, flagellomeres XIII dark distally, length ratio of flagellomeres I—XIII 11:13:10:12:13:13:13:13:13:13:13:75, AR 0.5. Pedicel ratio 1. CA 0.54, CP 1.06.

Thorax (fig. 14b): Brown in colour. Anteprepronotum very thin and without any V-shaped emargination. Acrostichals 12—14 in pairs, dorsocentrals 16—18 (18), humerals 2, prealars 5. Scutellum with 18—20 setae, postscutellum dark brown and bare.

Wing (fig. 14c): Cloudy especially along the margin of wing. Veins dark

brown, anterior veins more prominent than the posterior ones. Brachiolium with 1 seta. R with 21, R_1 with 15 and R_{4+5} with 35—38 setae; R_{2+3} meets C slightly away from R_1 , distance being 0.1 mm from R_1 ; ending of R_{4+5} and C blunt; r—m oblique and proximal to f—Cu; An ending below f—Cu. Wing with four irregular grey spots distributed as follows: (i) two in cell R_{4+5} near r—m and at the middle of the cell, (ii) one in cell M_{3+4} covering the base nearer to f—Cu and (iii) one at the middle of cell An. In addition to the above a grey streak runs below the vein M and the space between the spots in cell R_{4+5} along the apex. Wing length 1.64 (1.5—1.78, $n=8$) mm, breadth 0.6 (0.56—0.62, $n=8$) mm.

Legs (fig. 14d): Brown in colour. Femur with broad dark brown band at the proximal two-third and a small apical dark brown band, tibia with an apical dark brown band on all legs, rest of the legs pale to brown. Fore tibial scale narrowed and slightly pointed at the apex. Spur of mid tibia slightly bent and sharply pointed at the apex, 0.05 mm long, ratio of length of spur to the apical diameter of mid tibia 12:10; spur of hind tibia also bent and pointed, 0.055 mm long, ratio of length of spur to the apical diameter of hind tibia 13:12. Pulvilli split longitudinally.

Proportions and ratios of leg segments

	Fe	Ti	ta ₁	ta ₂	ta ₃	ta ₄	ta ₅	LR	TR
Fore	31	22	41	28	15	7	5	1.87	—
Mid	38	31	16	10	7	5	3	0.51	—
Hind	41	33	25	13	11	7	4	0.76	1.92

Abdomen: Brown to dark brown. Tergum I densely setaceous, rest of the segments with scattered setae.

Hypopygium (fig. 14e): Anal point long, apex pointed, base with two hook-like structures. Gonocoxite short and with 10—12 long setae; gonostylus very long, bowed and with 15—18 setae. Appendage I well developed, broad apex with numerous setae; appendage 2 long, apex slightly broad and with 8—10 long curved setae. Lateral sternapodeme 0.094 mm long, coxapodeme 0.051 mm long, phallapodeme 0.07 mm long. HR 0.66, HV 1.76.

Female: Unknown.

CHECK-LIST OF THE SPECIES OF THE GENUS *PLYPEDILUM* KIEFFER FROM INDIA

- albipalpus* n.sp., ♂, ♀, Raniganj (West Bengal)
angustiforceps Kieffer, ♂, Katihar (Bihar)
annulatipes (Kieffer), ♂, ♀, Puri (Orissa)
ascium n.sp., ♂, Bolpur (West Bengal)
brumale Kieffer, ♀, Giridih (Bihar)
chaudhurii n.sp., ♂, ♀, Burdwan (West Bengal)
fasciatipennis (Kieffer), ♀, Calcutta (West Bengal)
flagellatum n.sp., ♂, ♀, Raniganj (West Bengal)
griseoguttatum Kieffer, ♂, ♀, Burdwan and Calcutta (West Bengal)
insolitum n.sp., ♂, Digha (West Bengal)

- lineatum* n.sp., ♂, Raniganj (West Bengal)
lucidum n.sp., ♂, Burdwan (West Bengal)
milnei Kieffer, ♂, Berhampur (West Bengal)
nudiceps n.sp., ♂, ♀, Darjeeling (West Bengal)
numerus n.sp., ♂, Darjeeling (West Bengal)
pseudoflagellatum n.sp., ♂, Durgapur (West Bengal)
purimanus Kieffer, ♂, Calcutta (West Bengal)
rufomarginalis n.sp., ♂, ♀, Burdwan (West Bengal)
sealaenulus (Edwards), ♂, ♀, Barkuda Is. (Orissa)
tripartitum (Kieffer) ♂, ♀ (Orissa and West Bengal)
tripunctum n.sp., ♂, Darjeeling (West Bengal).

KEY TO THE SPECIES OF GENUS *POLYPEDILUM* KIEFFER IN WEST BENGAL

1. Wing with dark markings and clouds 2
- Wing unmarked 14
2. Thorax with bands or markings 3
- Thorax without bands or markings 8
3. Appendage 1 short and broad with setae 4
- Appendage 1 long and narrow without setae 6
4. AR less than 1. Abdomen with markings or bands *lineatum* n.sp.
- AR more than 1. Abdomen without markings or bands 5
5. Fore tibial scale pointed. Anal point tongue-like, constricted at the middle.....
- *griseoguttatum* Kief.
- Fore tibial scale blunt. Anal point narrow with pointed apex
- *annulatipes* Kief.
6. Abdominal terga I—VII with alternate dark brown and pale bands.....
- *insolitum* n.sp.
- Abdomen without such bands 7
7. Thorax yellow in colour. Coronal setae 4. Appendage 2 with a long setae.....
- *flagellatum* n.sp.
- Thorax red in colour. Coronal seta absent. Appendage 2 with normal setae
- *rufomarginalis* n.sp.
8. Anal point trifold 9
- Anal point simple 11
9. Fore femur with dark brown apical band. Appendage 1 flattened 10
- Fore femur without dark brown apical band. Appendage 1 narrow
- *chaudhurii* n.sp.
10. Anal point lanceolate, lateral branches of anal point short and blunt
- *lucidum* n.sp.
- Anal point long and pointed *tripunctum* n.sp.
11. Legs with bands on femur and tibia *brumale* Kieffer
- Legs without bands on femur and tibia 12
12. Appendage 1 club-shaped with numerous setae *numerus* n.sp.
- Appendage 1 simple with a few setae 13
13. Anal point hood-like and inturned *albipalpus* n.sp.
- Anal point simple *milnei* Kieffer

14. Thorax with bands or markings 15
 — Thorax without bands or markings 16
 15. Mid and hind tibia with brown apical band. Abdominal segments II, III, V and VI with dark brown bands *fasciatipennis* n.sp.
 — Mid and hind tibia without bands. Abdominal segments without such bands *ascium* n.sp.
 16. Abdominal segments with bands. Appendage 2 finger-like and uniform in diameter bearing incurved setae *nudiceps* n.sp.
 — Abdominal segments without band. Appendage 2 with narrow base and wide apex bearing incurved setae, outermost seta unusually long *pseudoflagellatum* n.sp.

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- Z. BOUČEK, A. WATSHAM and J. T. WIEBES. — The fig wasp fauna of the receptacles of *Ficus thonningii* (Hymenoptera, Chalcidoidea), p. 149—233, figs. 1—158, four colour-plates.

THE FIG WASP FAUNA OF THE RECEPTACLES OF *FICUS THONNINGII* (HYMENOPTERA, CHALCIDOIDEA)

by

Z. BOUČEK¹), A. WATSHAM²) and J. T. WIEBES³)

With 158 text-figures and four colour-plates

ABSTRACT

Records and descriptions of the chalcids reared from the receptacles of *Ficus thonningii* Bl. (*burkei* (Miq.) Miq., *petersii* Warb.) mainly in Zimbabwe-Rhodesia, among which the following new species: *Camarothorax brevimucro* Bouček, spec. nov.; *equicollis* Bouček, spec. nov.; *longimucro* Bouček, spec. nov. — *Crossogaster odorans* Wiebes, spec. nov. — *Eurytoma ficusgallae* Bouček, spec. nov. — *Ficomila* Bouček, gen. nov., type-species *Ficomila curtivena* Bouček, spec. nov.; *gambiensis* (Risbec) Bouček, comb. nov. from *Decatoma*. — *Otitesella tsamvi* Wiebes, spec. nov. — *Ormyrus flavipes* Bouček, spec. nov.; *subconicus* Bouček, spec. nov.; *watshami* Bouček, spec. nov. — *Philotrypesis parca* Wiebes, spec. nov. — *Syceurytoma* Bouček, gen. nov., type-species *Syceurytoma ficus* Bouček, spec. nov. — *Sycophila flaviclava* Bouček, spec. nov.; *kestraneura* (Masi) Bouček, comb. nov. from *Decatoma*; *modesta* Bouček, spec. nov.; *naso* Bouček, spec. nov.; *punctum* Bouček, spec. nov.; *sessilis* Bouček, spec. nov. — *Sycoryctes hirtus* Wiebes, spec. nov.; *remus* Wiebes, spec. nov. — *Sycoscapter cornutus* Wiebes, spec. nov. — *Sycotetra* Bouček, gen. nov., type-species *Sycotetra serricornis* Bouček, spec. nov. — *Watshamiella* Wiebes, gen. nov., type-species *Watshamiella alata* Wiebes, spec. nov. — The following known species are recorded from the receptacles of *Ficus thonningii*: *Alfonsiella brongersmai* Wiebes; *longiscapa* Joseph. — *Elisabethiella stuckenbergi* (Grandi). — *Phagoblastus barbarus* Grandi. — The following new species and combinations originate from other localities: *Camarothorax africanus* (Wiebes) Bouček, comb. nov. from *Sycobia* (ex *Ficus* cf. *eriobotryoides* K. & B., Sierra Leone); *imerinensis* (Risbec) Bouček, comb. nov. from *Callimomus* (Malagasy); *orientalis* (Wiebes) Bouček, comb. nov. from *Sycobia* (ex *Ficus reflexa* Thunb., Aldabra). — *Ormyrus chevalieri* (Risbec) Bouček, comb. nov. from *Monobaeus*; *decaryi* (Risbec) Bouček, comb. nov. from *Tribaeus*. — *Sycophila*, new combinations, all from *Decatoma*: *aethiopica* (Silvestri) Bouček; *cassinopsisi* (Risbec) Bouček); *nigrofasciata* (Risbec) Bouček; *ruandensis* (Risbec) Bouček; *rubra* (Risbec) Bouček; *xiphigaster* (Risbec) Bouček. — *Watshamiella infida* Wiebes, spec. nov. (ex *Ficus religiosa* L., Sri Lanka); *stilifera* (Wiebes) Wiebes, comb. nov. from *Sycoscapteridea* (ex *Ficus stupenda* Miq., North Borneo).

A key is given to the chalcids associated with the receptacles of *F. thonningii*, irrespectively whether coming from evidently galled ones or not. The species having a closer association with the fig, especially the pollinators, are also mentioned in the introductory description of the fig cycle and the chalcid wasp fauna of the best studied species of *Ficus* are reviewed.

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INTRODUCTION

For some years, one of us has been observing fig insects from what is called *Ficus burkei* on Chishawasha Mission, near Salisbury, Zimbabwe-Rhodesia. In the present paper, the general chapter on the fig cycle and the colour-plates are by his hand (A. W.). The insects collected were sent for identification to Europe, where they were divided into two lots, viz., the Agaonidae and the groups known as Sycoecini, Philotrypesini, Sycoryctini and Otitesellini (treated by J. T. W.), and the Epichrysomallinae, Eurytomidae and Ormyridae (treated by Z. B.). In a short chapter on the classification of chalcidoid fig wasps, some alterations are suggested as to their placement in one of the families Torymidae and Pteromalidae (Z. B.).

Some additional material was collected by Dr. M. G. Bingham (Lusaka) in Zambia, or taken from the BMNH collection. Also some colleagues from South Africa, viz., Dr. C. Eardley (Pretoria), Dr. S. Naser (Stellenbosch) and Dr. M. L. Penrith (Windhoek) kindly sent fig material when requested. In several instances, our treatment led to a revision of the genus or group concerned, and typical material of extralimital species or forms from other host *Ficus*, were requested on loan. Thanks are due to the curators of the following collections, for complying with our requests (the abbreviations of the institutes are those used throughout the text): British Museum (Natural History), London (BMNH); Cornell University, Entomology Department, Ithaca, N.Y.; Laboratorio di Entomologia, Bologna (LEB); Muséum National d'Histoire Naturelle, Paris (MNHN); Rijksmuseum van Natuurlijke Historie, Leiden (RMNH).

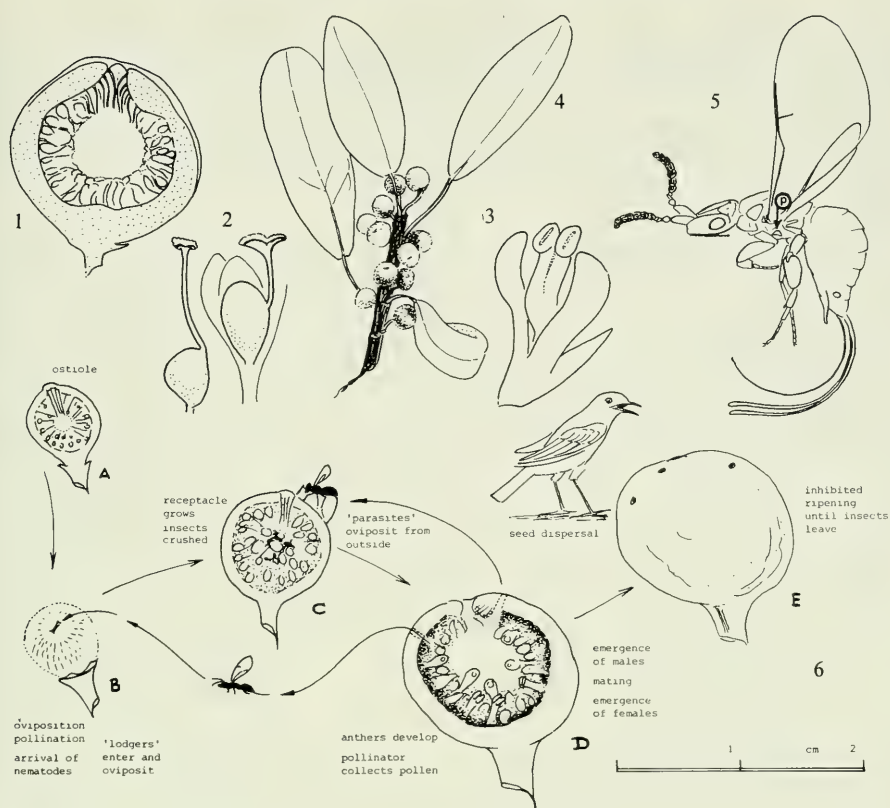
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THE FIG CYCLE

Ficus thonningii Blume is an extremely variable species in which can be included *Ficus burkei* (Miquel) Miquel and *F. petersii* Warburg, hitherto separated on minor differences in leaves and figs. Although their conspecificity is recognized, the names *F. burkei* and *petersii* are still used here, as samples have been sent under those names. In *Ficus thonningii* s.l. the trees are up to 15 m high. The leaves are obovate to elliptic or even lanceolate, glabrous or beneath pubescent, the apex is short-acuminate to obtuse, the base acute to rounded. The figs are borne in the leaf axils or just below the leaves, they are sessile or pedunculate, sparsely puberulous to densely pubescent. Material of *Ficus thonningii* is often confused with *Ficus natalensis* Hochstetter and *F. craterostoma* Mildbread & Burret. The latter two species are sometimes treated as distinct, by others considered as inseparable (e.g., Palmer, 1977: 85, 89).

When sectioned a fig can be seen to have a space in the centre, surrounded by



Figs. 1—6. *Ficus thonningii* Bl. and *Elisabethiella stuckenbergi* (Grandi). 1, section through a young fig (in the receptive stage B); 2, female florets, with styles of different lengths; 3, male floret (ripe in stage D); 4, general appearance of a twig with leaves and figs; 5, female fig wasp, showing pollen pockets (p); 6, the fig cycle, running from a young receptacle A, over B (in which the pollinators and the lodgers enter), C (in which most parasites oviposit) and D (from which the wasps of the new generation emerge), to the ripe fig E, the fruits of which are dispersed, a.o. by birds. (Scale to figs and insects of fig. 6).

florets, the outer layer being an enlarged receptacle (fig. 1). Bracts form an ostiole by which insects may enter; entrance is limited to those insects that are adapted to crawling through narrow places. Such adaptations of the female of *Elisabethiella stuckenbergi* (fig. 5) are seen in the legs, the wings and the head and antennae. The legs, hind and front, are powerfully developed, whereas the middle pair are not. The tibiae are short and strong, with numerous spines. The head has a sunken central membraneous region, which allows it to be deformed when entering, and protects part of the antennae. The mandibular appendage may assist her in forcing her way in. The trailing segments of the antennal club and funicle break off and the wings detach when she enters the fig.

At the early stage (B, fig. 6) it is comparatively easy for the female to crawl in through the ostiole. Inside there is a space for her, surrounded by an even layer of

stigmas (synstigma, Galil & Eisikowitch, 1968: 261¹). In the section of the fig it can be seen that the styles are of different lengths (fig. 2). The insect has a short ovipositor, which limits her ability to lay eggs in the florets with the shorter styles: in these the new generation of wasps will develop. The florets with the longer styles are more likely to become seeds. The receptacle is monoecious, the male florets are scattered amongst the female and there are relatively few (about 10%).

Ovipositing and pollinating will commence when the wasp has entered and proceed for some hours. If there are other insects also there, she will not be disturbed, but her ovipositing will be restricted. Other species may enter: of these *Crossogaster odorans* is the most common. Less common is *Phagoblastus barbarus*. Recently, it was published that a species of *Phagoblastus* pollinates the flowers of *Ficus vogelii* (Miq.) Miq. in Ghana, although it is not as efficient as is the Agaonid (*Allotriozoon heterandromorphum* Grandi). According to Newton & Lomo (1979: 29) this relative ineffectiveness of the *Phagoblastus* probably results from two factors. One is that the only pollen carried into the fig by the female wasp is that adhering to the outside of her body. The other factor is that transfer of pollen from the insect's body to the synstigma is probably a matter of chance, brought about as the insect crawls around. In *Ficus thonningii*, pollination is a deliberate act by the *Elisabethiella* and she carries the pollen in special pockets (fig. 5). After pollination, she cannot leave the fig, due to the arrangement of the ostiole, however, she has only a short time to live. Nematodes inside her will feed on her remains, growing rapidly to about 0.7 mm. They emerge from the gastral end as a number of large nematodes, twisted together, and inert. The species was recently described as *Parasitodiplogaster sycophilon* Poinar (1979). A general account on figs and nematodes was published by Martin et al. (1973).

Next to *Elisabethiella stuckenbergi*, there are two other Agaonids entering the receptacle in stage B, viz., *Alfonsiella brongersmai* and *longiscapa*. They may be lodgers in the fig, just as are the *Crossogaster* and *Phagoblastus*, and pollinate only occasionally. They have functional pollen pockets and pollen can sometimes be seen in them, but nothing is known of their behaviour. It is known for the *Elisabethiella*: while continuing oviposition, she periodically will stretch forward both head and thorax, and at the same time fold the legs back so that the feet touch the edges of the pollen pockets. It can be seen from the side that the thorax, which is normally arched, flattens out, drawing the coxae of the front legs forward and exposing the pockets. It is presumed that the pollen removed from the pockets with the feet is then applied to the stigmal surfaces as she rubs the feet about. The action may be done once, or repeated a number of times before pausing. Thus, five species are found to oviposit inside the fig, viz.,

Elisabethiella stuckenbergi (Grandi)

Alfonsiella brongersmai Wiebes

Alfonsiella longiscapa Joseph

Crossogaster odorans Wiebes

Phagoblastus barbarus Grandi

¹) General reference is here made to a series of papers by Galil and collaborators on the pollination of figs (review in Galil, 1977). Some of the terms used in the present paper were taken from Galil et al., as are the indications of the developmental stages of the receptacle.

The fig develops inwards. — After pollination, the florets and galls enlarge, completely filling the space, and crushing the remains of the insects. In this state, the nematods may be overlooked, but if the fig is cut up and placed in water, they can be found.

A number of species of chalcids oviposit through the skin of the fig. They have various methods of forcing the ovipositor through the hard receptacle, as described by several authors (review in Wiebes, 1977: 224—227, fig. 8). Some are evidently adapted to this task by the structure of their ovipositing organs, which they can raise high over the substratum, or they can guide the ovipositor by the long valves. Other species are quite normal and have their ovipositor concealed in the gaster. Some are known to behave as the cuckoo and have been termed “cleptoparasites”. They lay their eggs later than the wasps that enter the fig, and they tend to emerge before, so their rate of development is faster. They cannot themselves cause the florets to develop, so have to rely for their larval food on one already started. Some take only plant tissue prepared by the Agaonid, e.g. this is known for *Philotrypesis caricae* (L.) from the Common Fig. Other species are supposed, by their being noticeably smaller than the other wasps, to be parasitoids of any of the other larvae, killing it and eating its body contents. The following is a list of those to be found ovipositing from the outside:

<i>Philotrypesis parca</i> Wiebes	<i>Ficomila curtivena</i> Bouček
<i>Watshamiella alata</i> Wiebes	<i>Ficomila gambiensis</i> (Risbec)
<i>Sycoscapter cornutus</i> Wiebes	<i>Sycophila kestraneura</i> (Masi)
<i>Sycoryctes remus</i> Wiebes	<i>Sycophila punctum</i> Bouček
<i>Sycoryctes hirtus</i> Wiebes	<i>Sycophila sessilis</i> Bouček
<i>Otitessella tsamvi</i> Wiebes	<i>Sycophila modesta</i> Bouček
<i>Sycotetra serricornis</i> Bouček	<i>Sycophila naso</i> Bouček
<i>Camarothorax equicollis</i> Bouček	<i>Sycophila flaviclava</i> Bouček
<i>Camarothorax longimucro</i> Bouček	<i>Ormyrus watshami</i> Bouček
<i>Camarothorax brevimucro</i> Bouček	<i>Ormyrus flavipes</i> Bouček
<i>Eurytoma ficusgallae</i> Bouček	<i>Ormyrus subconicus</i> Bouček
<i>Syceurytoma ficus</i> Bouček	

It should be stated that we found it difficult to draw a line between the obligatory fig wasps and those which apparently have a looser or even very loose association with the figs. We have included in the study the chalcids which frequently occur in the galled receptacles, whether these finally develop into normal or sub-normal syconia. However, there are a number of other insects that use figs as a suitable niche, but are not closely associated with them. Even if they are sometimes present in considerable numbers, as e.g., parasites of dipterous eggs deposited into the tissues of the fig, or of other insects using the fig in a similar way, they are regarded as being out of the scope of this paper. The chalcids associated with such facultative inhabitants of the figs belong mostly to the genera *Eupelmus* Dalman, *Anastatus* Motschulsky, *Pediobius* Walker, *Tetrastichus* Haliday, etc.

The fig grows outwards. — As the fig grows, the central space will be formed again. This allows more freedom of movement. Nematode eggs can be found between the bracts of the florets. Inside the eggs, the juvenile nematode can be

seen sliding about. As the space is formed in the centre of the fig, the male insects start to emerge from their galls. This can be encouraged by opening the nearly developed fig.

The male *Elisabethiella* makes an opening in his gall and sits on the edge of the gall. He looks with the aid of his antennae for galls containing females of his species, which are usually in one region. There is probably something in them that attracts him, as he will continue to open a female gall even when she has been removed. He bites a hole in the female gall and inserts the tubular segments of his gaster and mates. This process takes about half a minute from finding to insertion. He continues looking for females.

Other wingless males emerge at the same time. These leave their own galls and go in search of the females: in the species which oviposit from the outside, perhaps they are more scattered than the *Elisabethiella*, and so need to be looked for. The males bite an opening into the female gall and slip in to mate with her inside. This behaviour may be different for the different species, but this can be more easily studied now they have been distinguished and described.

As the males are very similar to each other, and differ completely from the females, in most cases it was necessary to collect mating pairs. As each pair mated, they were collected. The winged females can be collected on forceps and presented to the males. The other species will reject them, while the correct one will stroke her face and then mount and mate. Later in this stage (fig. 6, D), the *Elisabethiella* males make several openings in the receptacle and the females start to leave.

When the *Elisabethiella* female crosses an anther, she is stimulated to collect pollen. She rubs her fore legs as though wiping the feet on a mat, and raises them to place the pollen into the pockets. After having crawled out of the receptacle, she flies off. The complete cycle may take about 50 to 60 days, though it is variable. *Ficus capensis* Thunb. takes about this time, and it is quite easy to find fruit at different stages, most of the year. The *Ficus burkei* seems to have a similar lot of fruit available, but it is not always so easy to find. At certain times there is much ripe fruit and many thousands of insects are emerging, but it is difficult to find any trees with young fruit that would receive these insects. This may be due to the fact that trees are cut for firewood. A careful search will reveal fruit at different stages of development.

Nematodes can be seen in the newly emerged insects. At first they are crawling over the insects in the moist conditions of the fig. More than twenty can be seen easily. If the emerged insects are kept for a day in a plastic bag, fewer nematodes are seen on the outside, and some are found inside the thorax (sometimes in the pollen pockets) and gaster. They can be seen moving about, displacing the contents of the gaster. At this time they are about 0.4 mm long.

The final ripening of the fig fruit. — According to Galil et al. (1973) opening of the figs allows an increase of ethylene, which encourages the final ripening of the fruit. So the insects are protected while they remain in the fig and no emergence holes have yet been made. Once the insects emerge, the fig begins to ripen and birds such as Glossy Starlings and other fruit-eating birds, also the Fruit Bats, feed on the ripe figs and aid in the dispersal of the seeds.

Other insects are to be found in the fig, but they are not concerned with the cycle of the fig. These include Lepidoptera, weevils (Coleoptera) and several Hemiptera. Diptera that are interested in ripening fruit may also be found (see an interesting paper by Lachaise, 1977).

THE FIG WASP FAUNA FROM *FICUS THONNINGII* COMPARED WITH THAT FROM OTHER FIGS

The main purpose of the present paper is to give a survey of all chalcids reared from one species of fig, in order to make their symbioses open to further research. Compared to what we know of the entomofauna associated with other species of *Ficus*, that of *Ficus thoningii* is now the best known, while that of the Indian *Ficus benghalensis* is the next best. In general, however, our knowledge of the fig-fauna is scanty: hopefully, our survey will persuade other entomologists to study the wasps of figs within their reach.

In table 1 a survey is presented of selected figs and their chalcid fauna. Most sections of Old World *Ficus* (see Corner, 1965) are represented, but five had to be excluded for lack of relevant data (viz., *Stilpnophyllum* Endl., *Rhizocladus* Endl., *Kalosyce* (Miq.) Corner, *Sinosycidium* Corner and *Adenosperma* Corner). In the accompanying list, the references are given that can not be found in the host catalogue (Wiebes, 1966 b). The data lead to the following conclusions. Generally, the Agaonid genera, or in some instances species-groups, are specific to their host-section(s): members of the subfamily Agaoninae are restricted to two sections of *Ficus*, the African representatives of which also harbour Sycoecinae (but see Wiebes, 1974 b for the Indo-Malayan relatives). The Sycophagini (one species of *Parakoebelea* excepted, see Joseph, 1957: 100) and the Apocryptini are restricted to figs pollinated by *Ceratosolen*. The Otitesellinae (with very few exceptions, not listed; see Wiebes, 1974 d) are restricted to the sections of subgenus *Urostigma* and to section *Oreosyce*.

Special attention is drawn to cases where more than one Agaonid are present (nos. 18, 19, 35, 36, 78), where several species of parasitic wasps are present (nos. 8, 17, 41, 45, 48, 49, 50), or where one species was recorded from different species of *Ficus* (nos. 71, 77; 47, 84; 48-2, 85; 49-5, 86). The list is not in all instances definitive because some of the groups mentioned are still in need of revision.

I. Section *Urostigma* (Gasp.) Miq.

Ficus religiosa L. (see Wiebes, 1967: 419—434): 1, *Platyscapa quadraticeps* (Mayr) (Wiebes, 1977 b: 214); 2, *Philotrypesis anguliceps* (Westwood) (Abdurahiman & Joseph, 1975 b: 78); 3, *Sycoryctes religiosae* Wiebes; 4, *Sycoscapteridea monilifera* (Westwood); 5, *Watshamiella infida* Wiebes*; 6, *Eurytoma* spec.

II. Section *Conosyce* (Miq.) Corner

Ficus benghalensis L. (see Wiebes, 1967: 400—419): 7, *Eupristina masoni* Saunders; 8, *Philotrypesis transiens* (Walker) & *affinis* (Westwood); 9, *Sycoscapter stabilis* (Walker) (*S. insignis* Westwood, 1883: 35, ♂; *Indothymus crenulatus* Joseph, 1953: 77, ♀); 10, *Sycoryctes* spec.; 11, *Sycoscapteridea gurui* Joseph & Abdurahiman (1969: 42); 12, *Micranisa pteromaloides* (Walker); 13, *Walkerella temeraria* Westwood (Joseph & Abdurahiman, 1969: 44); 14, *Sycobia bethyloides* Walker; 15, *Sycophilodes moniliformis* Joseph; 16, *Sycophilomorpha saptapurensis* Joseph & Abdurahiman

Table 1. Groups and selected genera of fig insects, with the *Ficus* species from which they were reared.

		<i>Ficus</i> :													
Fig wasps:		<i>religiosa</i>	<i>benghalensis</i>	<i>stupenda</i>	<i>macrophylla</i>	<i>erobotryoides</i>	<i>thomningii</i>	<i>callosa</i>	<i>narica</i>	<i>enacarpata</i>	<i>laterifolia</i>	<i>nota</i>	<i>variegata</i>	<i>racemosa</i>	<i>gynomorpha</i>
Blastophaginae	<i>Platyscapa</i>	1	.	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Eupristina</i>	.	7	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Waterstoniella</i>	.	.	18	.	.	.	.	.	.	.	.	.	.	.
	<i>Blastophaga</i>	.	.	19	.	.	.	.	55	.	.	.	.	.	.
	<i>Dolichorhis</i>	.	.	.	.	.	.	51	.	.	.	.	.	.	.
	<i>Kradibia</i>	.	.	.	.	.	.	.	.	58	61	.	.	.	.
	<i>Ceratosolen</i>	.	.	.	.	.	.	.	.	.	.	63	68	72	78
Agaoninae	<i>Pleistodontes</i>	.	.	.	25	.	.	.	.	.	.	.	.	.	.
	<i>Allotriozoon</i>	.	.	.	.	29	.	.	.	.	.	.	.	.	.
	<i>Elisabethiella</i>	.	.	.	.	.	35	.	.	.	.	.	.	.	.
	<i>Alfonsiella</i>	.	.	.	.	.	36	.	.	.	.	.	.	.	.
Sycoecinae	<i>Crossogaster</i>	.	.	.	.	.	37	.	.	.	.	.	.	.	.
	<i>Phagoblastus</i>	.	.	.	.	.	38	.	.	.	.	.	.	.	.
Sycophagini	<i>Sycophaga</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	79
	<i>Eukoebelea</i>	.	.	.	.	.	.	.	.	.	.	64	69	73	80
	<i>Parakoebelea</i>	.	.	.	.	.	.	.	.	.	.	.	.	74	81
	<i>Idarnes</i>	.	.	.	.	.	.	.	.	.	.	.	.	75	82
Apocryptini	<i>Apocrypta</i>	.	.	.	.	.	.	.	.	.	.	65	.	76	83
Philotrypesini	<i>Philotrypesis</i>	2	8	.	26	30	39	.	56	59	.	66	70	.	.
Sycoryctini	<i>Sycoscapter</i>	.	9	20	.	31	40	.	.	.	62	.	.	.	.
	<i>Arachonia</i>	.	.	21	.	.	.	.	.	.	.	.	.	.	.
	<i>Sycoryctes</i>	3	10	22	27	32	41	52	.	.	.	67	71	77	.
	<i>Sycorycteridea</i>	.	.	.	.	.	.	53	.	.	.	.	.	.	.
	<i>Sycoscapteridea</i>	4	11	.	.	.	.	.	57	60	.	.	.	.	.
	<i>Watshamiella</i>	5	.	23	.	.	42	.	.	.	.	.	.	.	.
Otitesellinae	<i>Otitesella</i>	.	.	.	.	33	43	.	.	.	.	.	.	.	.
	<i>Micranisa</i>	.	12	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Walkerella</i>	.	13	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Grandiana</i>	.	.	24	.	.	.	.	.	.	.	.	.	.	.
	<i>Grasseiana</i>	.	.	.	.	.	.	54	.	.	.	.	.	.	.
Epichrysomallinae	<i>Sycobia</i>	.	14	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Pembertonia</i>	.	.	.	28	.	.	.	.	.	.	.	.	.	.
	<i>Sycophilodes</i>	.	15	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Sycophilomorpha</i>	.	16	.	.	.	.	.	.	.	.	.	.	.	.
	<i>Sycotetra</i>	.	.	.	.	.	44	.	.	.	.	.	.	.	.
	<i>Camarothorax</i>	.	.	.	.	34	45	.	.	.	.	.	.	.	.
Eurytominae	<i>Eurytoma</i>	6	.	.	.	.	46	.	.	.	.	.	.	.	.
	<i>Syoeurytoma</i>	.	.	.	.	.	47	.	.	.	.	.	.	.	84
	<i>Ficcomila</i>	.	.	.	.	.	48	.	.	.	.	.	.	.	85
	<i>Sycophila</i>	.	17	.	.	.	49	.	.	.	.	.	.	.	86
Ormyrinae	<i>Ormyrus</i>	.	.	.	.	.	50	.	.	.	.	.	.	.	.

(1969: 37); 17, *Sycophila decatomoides* Walker and other species (? *Decatoma*, Joseph & Abdurahiman, 1968).

Ficus stupenda Miq. (see Wiebes, 1966 b: 163—192): 18, *Waterstoniella masii* (Grandi); 19, "Blastophaga" errata Wiebes; 20, *Sycoscapter reticulatus* Wiebes; 21, *Arachonia borneensis* Wiebes; 22, *Sycoryctes hilli* Wiebes; 23, *Watshamiella stilifera* (Wiebes)*; 24, *Grandiana corneliae* Wiebes.

III. Section *Malvanthera* Corner

Ficus macrophylla Desf. ex Pers.: 25, *Pleistodontes froggatti* Mayr; 26, *Philotrypesis aterrima* Saunders; 27, *Sycoryctes australis* (Froggatt); 28, *Pembertonia ficicola* Gahan.

IV. Section *Galoglychia* (Gasp.) Endl.

Ficus cf. *eriotryoides* K. & B. (see Wiebes, 1971: 367—383): 29, *Allotriozone prodigiosum* Grandi; 30, *Philotrypesis finitimorum* Wiebes; 31, *Sycoscapter montis* Wiebes; 32, *Sycoryctes lomaensis* Wiebes; 33, *Oritesella royi* Wiebes; 34, *Camarothorax africanus* (Wiebes)*.

Ficus thonningii Bl. (present paper): 35, *Elisabethiella stuckenbergi* (Grandi); 36, *Alfonsiella brongersmai* Wiebes & longiscapa Joseph; 37, *Crossogaster odorans* Wiebes*; 38, *Phagoblastus barbarus* Grandi; 39, *Philotrypesis parca* Wiebes*; 40, *Sycoscapter cornutus* Wiebes*; 41, *Sycoryctes remus* Wiebes* & *hirtus* Wiebes*; 42, *Watshamiella alata* Wiebes*; 43, *Oritesella tsamvi* Wiebes*; 44, *Sycotetra serricornis* Bouček*; 45, *Camarothorax equicollis* Bouček*, *longimucro* Bouček* & *brevimucro* Bouček*; 46, *Eurytoma ficusgallae* Bouček*; 47, *Syceurytoma ficus* Bouček*; 48, *Ficomila curtivena* Bouček* & *gambiensis* (Risbec)*; 49, *Sycophila kestraneura* (Masi)*, *punctum* Bouček*, *sessilis* Bouček*, *modesta* Bouček*, *naso* Bouček* & *flaviclava* Bouček*; 50, *Ormyrus watshami* Bouček*, *subconicus* Bouček* & *flavipes* Bouček*.

V. Section *Oreosycea* (Miq.) Corner

Ficus callosa Willd.: 51, *Dolichoris malabarensis* (Abdurahiman & Joseph) (Wiebes, 1979 a: 188); 52, *Sycoryctes callosa* Abdurahiman & Joseph (1975 a: 103); 53, *Sycorycteridea keralensis* Abdurahiman & Joseph (1975 a: 99); 54, *Grasseiana callosa* Abdurahiman & Joseph (1967: 14).

VI. Section *Ficus* L.

Ficus carica L.: 55, *Blastophaga psenes* (L.); 56, *Philotrypesis caricae* (L.); 57, *Sycoscapteridea raoi* Joseph.

VII. Section *Sycidium* Miq.

Ficus exasperata Vahl: 58, *Kradibia gestroi* (Grandi) (Wiebes, 1978 a: 176); 59, *Philotrypesis quadrisetosa* (Westwood); 60, *Sycoscapteridea longipalpus* (Joseph).

Ficus laterifolia Vahl: 61, *Kradibia cowani* Saunders (Wiebes, 1978 a: 174); 62, *Sycoscapter gibbus* Saunders (Wiebes, 1978 b: 187).

VIII. Section *Sycocarpus* Miq.

Ficus nota (Blanco) Merr.: 63, *Ceratosolen notus* (Baker); 64, *Eukoebelea nota* (Baker); 65, *Apocrypta larvalis* (Baker); 66, *Philotrypesis similis* Baker; 67, *Sycoryctes bakeri* Wiebes.

IX. Section *Neomorpha* King

Ficus variegata Bl.: 68, *Ceratosolen appendiculatus* (Mayr); 69, *Eukoebelea spinatarsus* (Mayr); 70, *Philotrypesis bimaculata* Mayr; 71, *Sycoryctes patellaris* Mayr.

X. Subgenus *Sycomorus* (Gasp.) Miq.

Ficus racemosa L.: 72, *Ceratosolen fusciceps* (Mayr); 73, *Eukoebelea brevitarsis* (Grandi); 74, *Parakoebelea stratheni* Joseph; 75, *Idarnes testacea* (Mayr); 76, *Apocrypta westwoodi* Grandi; 77, *Sycoryctes patellaris* Mayr.

Ficus sycomorus L. (see Wiebes, 1968: 307—320): 78, *Ceratosolen arabicus* Mayr & *galili* Wiebes; 79, *Sycophaga sycomori* (L.); 80, *Eukoebelea sycomori* Wiebes; 81, *Parakoebelea gigas* (Mayr); 82, *Idarnes gracilis* Wiebes; 83, *Apocrypta longitarsus* Mayr; 84, *Syceurytoma ficus* Bouček*; 85, *Ficomila gambiensis* (Risbec)*; 86, *Sycophila naso* Bouček*.

REFLECTIONS ON THE CLASSIFICATION OF CHALCIDOID FIG WASPS

It is still rather premature to give proper taxonomic assignment of most

* New species or new combination published in the present paper.

chalcidoid groups associated with the figs, to the families as they are recognised today. It can be said that the closer is this association, the more difficult it is to trace the links with the most closely related non-fig-associated groups. Despite certain controversies most authors agree that the genus *Ficus* was already present and abundant in the Cretaceous period. However, there is but one fossil record of an Agaonid (Brues, 1910) and also records of the other Chalcidoidea are very scanty, especially of the groups of the "pteromaloid complex", i.e., families most closely related to Pteromalidae, including Torymidae, Eurytomidae and Agaonidae. So far the main source has been an analysis of the morphological characters, supplemented by some biological evidence. This analysis seems to suggest that at least some of the relevant groups have nothing to do with the Torymidae under which most of the fig wasps (apart from Agaonidae) have been recently classified.

Agaonidae are best regarded as a separate family. However, it seems possible that the "unplaced" Sycoecinae are related to them, probably as a plesiomorphic (less specialised) group, pointing perhaps to a common origin of both groups in the pteromaloid complex. All the same it must be stressed that a placement of Sycoecinae in Agaonidae is still very problematic.

Apart from the neotropical genus *Physothorax* Mayr, which undoubtedly belongs to Torymidae, subfamily Toryminae, two other groups seem to have closer links with Torymidae, viz., Apocryptini and Sycophagini. They might be regarded as two tribes of a special subfamily Sycophaginae. Another, but more questionably torymid subfamily may constitute the Sycoryctinae. They may include two tribes, Sycoryctini (here also the neotropical *Critogaster* Mayr) and Philotrypesini. Both are undoubtedly closely related, but there are almost as many reasons to classify them under Pteromalidae as are in favour of the Torymidae.

A few further groups seem to be placed best in the family Pteromalidae. Here belong Otitesellinae which include, apart from several palaeotropical genera (listed e.g., in Hill, 1967) also the neotropical *Aepocerus* Mayr and *Heterandrium* Mayr. Yet another pteromalid subfamily, although completely different from Otitesellinae, may be Epichrysomallinae. They may retain the subfamily status, being sufficiently different from, although related to, the Brachyscelidiphaginae (*Epichrysomalla* Girault was originally described along with several genera of the latter group), possibly as their apomorphic sister group, as suggested by *Leeweniella* Ferrière. Both groups are of phytophagous habits, but Epichrysomallinae are associated exclusively with figs (palaeotropical), galling the female florets as do the Agaonidae, but apparently ovipositing through the fig wall. Otherwise the coiled ovipositor reminds us much of certain Eurytomidae. However, Epichrysomallinae do not seem to be closely related to the eurytomids, as found independently, on other evidence, also by M. Copland (*in litt.*).

The remaining groups Eurytomidae and Ormyridae do not pose many problems, but it should be noted that the latter group shows close relationship with Torymidae and should perhaps be better regarded as a subfamily of Torymidae, as they were in the past.

Thus, in the present paper the following classification is used:

Family	Subfamily	Tribe
Agaonidae	Agaoninae	
	Blastophaginae	
(not placed)	Sycoecinae	
Torymidae	Toryminae	
	Sycophaginae	Sycophagini
		Apocryptini
	Ormyrinae	
Torymidae	Sycoryctinae	Philotrypesini
or Pteromalidae		Sycoryctini
Pteromalidae	Otitesellinae	
	Epichrysomallinae	
Eurytomidae	Eurytominae	

In the following descriptive part, the groups are treated in the sequence of the above classification, which is that given by their association with the figs; for the reason of their rather loose association with *Ficus*, however, the Ormyrinae are treated last. The Blastophaginae and Sycophaginae are not represented in *Ga-loglychia*-figs, as is evident from table 1.

KEY TO THE FIG WASPS FROM *FICUS THONNINGII*

1. Fully winged, females and males 2
- Apterous or brachypterous, males only 36
2. Females: gaster with distinct tail formed either by the ovipositor and its sheaths, or also by extremely narrowed last one or two tergites 3
- Females without such a slender tail: ovipositor sheaths short, hardly exserted; or males, i.e., with last sternite virtually reaching apex of gaster 12

WINGED FEMALES WITH TAILS

3. Narrow gastral tail formed for a great part by one or two ultimate tergites ... 4
- Last tergite short, tail formed by the ovipositor and its sheaths 8
4. Tail formed in anterior part by two ultimate tergites (the proximal of which is recognizable by the very small spiracular peritremes) and, in hinder portion, by long protruding ovipositor and sheaths (Philotrypesini) *Philotrypesis parca*
- Tail formed by the last tergite, i.e., the apparent gaster ending with the eighth urotergite, which bears the spiracular peritremes (Sycoryctini) 5
5. Stigmal vein produced into a boot-like stigma (fig. 64), the fore wing with long setae in the marginal-stigmal angle; the epistomal margin produced into an acute projection (fig. 65) *Sycoscapter cornutus*
- Stigmal vein more normal, the wings at most with some long setae along the veins (but may be pilose all over); the epistomal margin straight or with wide lobes 6
6. Epistomal margin widely lobed (fig. 68); the wings hyaline but for some

- setae along the veins (*Sycoryctes*) 7
- Epistomal margin straight (fig. 62); the wings evenly pilose *Watshamiella alata*
7. The legs up to and including the tibiae dark *Sycoryctes remus*
- The legs from the femora onwards yellowish *Sycoryctes hirtus*
8. Antennal scape strongly broadened; prognathous head with mandibles provided with a denticulate appendage; marginal vein normal and slender, postmarginal short but not rudimental (Agaoninae) 9
- Antenna of more normal form; mandibles without such appendage, although they bear teeth directed backwards; marginal vein thickened and longer than rudimental postmarginal (Sycoecinae) 11
9. Funicular segments of antenna with sensilla linearia. General aspect, fig. 5 *Elisabethiella stuckenbergi*
- Funicular segments of antenna with long flexible sensilla chaetica (*Alfonsiella*) 10
10. Head scarcely longer than wide (fig. 14), mandibular appendage with twenty ventral rows of teeth; antennal scape not produced. *Alfonsiella brongersmai*
- Head distinctly longer than wide (fig. 15), mandibular appendage with thirty-five ventral rows of teeth; antennal scape with an apical process. *Alfonsiella longiscapa*
11. Antenna with one anellus, funicle with long sensilla chaetica; fore tibia with a dorso-apical, bidentate hook *Crossogaster odorans*
- Antenna with two anelli, funicle with sensilla linearia; fore tibia with a comb of conical teeth *Phagoblastus barbarus*

WINGED FEMALES WITHOUT TAILS AND WINGED MALES

12. Gaster with at least some coarse sculpture; marginal vein very long, at least seven times as long as short stigmal vein; antenna thirteen-segmented, with two anelli (Ormyrinae) 13
- Gaster without any coarse sculpture, either smooth or virtually so; marginal vein never so much longer than the stigmal vein 15
13. Mid lobe of mesoscutum in both sexes mainly bare, pilosity reduced to few dark bristles on posterior half; in ♀ gaster mostly not longer than head plus thorax combined, dorsally keeled; femora and tibiae dark; in ♂ legs and sides of thorax testaceous, gaster flat and shiny, two middle tergites usually each with two exposed rows of deep foveolae *Ormyrus watshami*
- Mesoscutum (and scutellum) all over with regular subdecumbent pilosity; other characters also partly different 14
14. Femora and tibiae in both sexes testaceous; in ♀ gaster anteriorly rather high, compressed, but its apical third (from middle of sixth tergite) abruptly narrowed and slightly upturned; middle tergites each with a row of raised short ridges but deep foveolae at base of tergites often concealed; in ♂ gaster slightly dull (also between foveolae), fairly densely punctulate *Ormyrus flavipes*
- Femora, sometimes also tibiae, in both sexes more or less infusate and

- pedicellus slightly shorter than in alternate; in ♀ gaster not high, almost gradually tapering, subconical, usually tergites 3 to 5 with exposed deep foveolae at base, just in front of serrate rows of short ridges; in ♂ gaster with distinct smooth interspaces between deep foveolae . . . *Ormyrus subconicus*
15. Body with metallic gloss, very finely reticulate; in ♀ apex of gaster slightly curving ventrad (Otitesellinae) *Otitesella tsamvi*
- Body non-metallic, frequently either almost smooth or with distinct sculpture on thorax and mostly also on head; apex of gaster in ♀ often curving dorsad, never ventrad 16
16. Thorax (and head) with distinct sculpture and pubescence; stigmal vein usually at acute angle or short marginal vein distinctly expanded (Eurytomiinae) 17
- Body without distinct sculpture, although often microscopically alutaceous; thorax always with pubescence reduced to pairs of bristles; marginal vein not so short or, if so, then stigmal vein arising at nearly right angle 26
17. Gena posteriorly with strong and distinctly raised carina extending up the temple; thorax densely umbilicately punctured 18
- Gena posteriorly with an edge which is blunt or at most indistinctly carinate in middle or at mandible; umbilicate punctures, if present on thorax, usually not very dense 19
18. Marginal vein distinctly swollen; gaster on distinct petiole which has anteriorly a transverse crest; fore coxa antero-ventrally flat; mesosternal shelf very short, in middle with small rounded projection which is hollowed from both sides; genal carina smoothly joining mouth margin; body usually extensively rufous, in darkest specimens at least ventrally . . *Syceurytoma ficus*
- Marginal vein normal, slender; gaster in ♀ virtually sessile; fore coxa on antero-ventral surface with strong oblique carina; mesosternal shelf separated by sinuate cross-carina; genal carina with a tooth at base of mandible; body black, legs beyond coxae usually orange *Eurytoma ficusgallae*
19. Mesosternal part of thorax with distinct though not high median projection excavated from the sides and, sublaterally, with slight carina marking off mesosternal shelf; marginal vein in ♀ not longer than stigmal vein which is usually distinctly curved; wing sometimes without fuscous spot (macula) (*Ficomila*) 20
- Mesosternum regularly sloping, posteriorly with median hairy depression (at mid coxae), but without any indication of delimited mesosternal shelf; marginal vein always with fuscous macula and frequently longer than the stigmal vein (*Sycophila*) 21
20. In ♀ gaster dorsally broad, with fourth tergite about twice as long as the third; thorax dorsally almost always black, with dense umbilicate puncturation and conspicuous white pubescence; fore wing whitish, without infusate macula, its pilosity, including marginal fringe, very short, inconspicuous; ♂ unknown *Ficomila curtivena*
- In ♀ gaster compressed from sides, dorsally subcarinate, its fourth tergite hardly longer than the third; thorax usually yellowish, its pilosity and puncturation often not conspicuous; fore wing with small fuscous macula on marginal vein *Ficomila gambiensis*

21. Pedicel in both sexes distinctly shorter than first funicular segment; marginal vein swollen, i.e. with its lower margin convex, often strongly so (in dark larger ♂); in ♀ wing below submarginal vein bare or with up to 2 hairs and petiole distinctly elongate (about 1.5×1), gaster compressed, dorsally keeled *Sycophila kestraneura*
- Pedicel nearly as long as or even longer than first funicular segment; marginal vein widening distad but its lower margin (sometimes obscured by macula) either straight or even concave; partly different also in other characters 22
22. Exposed part of prepectus with some hairs (fig. 144); in ♀ wing below submarginal vein bare or with up to 2 hairs only; marginal vein only moderately widened and rather short, macula small, usually round and not reaching base of marginal vein; in ♂ head subglobose, stout, 1.5—1.65 times as broad as long in dorsal view *Sycophila punctum*
- Prepectus completely bare (occasionally with 1—2 hairs in *sessilis*); in ♀ wing below submarginal vein at least with a sparse hairline on basal fold; in ♂ head more transverse than in alternate 23
23. Gaster in ♀ virtually sessile (fig. 148) as dorsal part of petiole is strongly transverse; ♂ unknown *Sycophila sessilis*
- Gaster distinctly petiolate in both sexes, petiole in ♀ mostly elongate in dorsal view 24
24. Malar space slightly shorter than, or at most virtually as long as half of longest diameter of eye, lower extremity of eye subangular (fig. 150); in ♀ antenna darkened but with yellow apex; interantennal crest rather steep into scrobal cavity *Sycophila flaviclava*
- Malar space at least slightly longer than half of longest eye diameter, eye broadly rounded in lower part (figs. 149, 151, 152); antenna in ♀ uniformly darkened, not yellow at apex 25
25. Fore wing on dorsal surface of costal cell in ♀ with distinct row of erect hairs; interantennal crest gradually descending into scrobal cavity; ♀ gaster usually with darker bands on anterior tergites; pedicel at most about 2.2 times as long as broad *Sycophila modesta*
- Dorsal surface of costal cell in ♀ bare or at most with odd hair; interantennal crest mostly perpendicularly descending into scrobes, forming a subrectangular tooth; ♀ gaster usually unicoloured, yellowish or blackish; pedicel in both sexes with flat dorsal outline, usually more than $2\frac{1}{2}$ times as long as broad *Sycophila naso*
26. Only males: fore wing wholly pilose, narrow, marginal vein very long and postmarginal fully twice as long as the stigmal; antennal flagellum not or hardly longer than scapus *Watshamiella alata*
- Both sexes; in male venation different, wing at base extensively bare, flagellum longer 27
27. Only males: marginal vein thickened and at least 1.9 times as long as the stigmal, wing in area below marginal vein and parastigma pubescent; head flat, with long mandibles (Sycoecinae) 28
- Both sexes: in male marginal vein not so long and thickened, area below this vein at least partly bare; head different (Epichrysomallinae) 29

28. Head virtually as long as wide, with antennal toruli partly below lower ocular line; marginal vein fully twice as long as the stigmal; outer tooth of mandible shorter than the inner tooth (fig. 36) *Crossogaster odorans*
 — Head slightly but distinctly longer than wide, with antennal toruli distinctly above ocular line; marginal vein not quite twice as long as the stigmal; outer tooth of mandible longer than inner tooth (fig. 37) .. *Phagoblastus barbarus*
29. Tarsi 4-segmented; notauli very superficial, in form of dark lines not nearly reaching transscutal line; scutellum anteriorly separated from axillae only by lines, not by grooves; funicular segments in both sexes separated by distinct incisions, in ♀ funicle serrate and 6-segmented, in ♂ 5-segmented *Sycotetra serricornis*
 — Tarsi 5-segmented; notauli groove-like, complete or nearly so (some ♂); axillar grooves also complete; flagellar segments in ♀ never serrate, flagellum fairly compact and sometimes with different number of segments; in ♂ funicle either with 5 or 7 segments (*Camarothorax*) 30
30. Females (gaster compressed, high, dorsally keeled) 31
 — Males (gaster flat, much shorter than thorax) 33
31. Antenna with 7 funicular segments plus small anellus; pedicel subglobose *Camarothorax equicollis*
 — Only 6 funicular segments, a small anellus and an elongate pedicel (at least 1.6×1) 32
32. Gaster strongly compressed, about as long as head plus thorax, its hypopygium not quite reaching two-thirds along ventral edge but bearing at apex a long thin whitish projection; clypeus dorsally separated from supraclypeal area by distinct line *Camarothorax longimucro*
 — Gaster relatively broader and only about as long as thorax, hypopygium reaching near to apex of gaster and bearing a short projection; clypeus dorsally not separated from supraclypeal area .. *Camarothorax brevimucro*
33. Antenna with 5 funicular segments; clypeus not separated dorsally from supraclypeal area; body yellowish *Camarothorax brevimucro*
 — With 7 funicular segments; clypeus separated dorsally by a dark line from supraclypeal area; body often brownish 34
34. Head and pronotum unusually long, each longer than broad; notaular grooves almost meeting at scutellum *Camarothorax equicollis*
 — Head and pronotum shorter, each at least slightly broader than medially long; notauli more apart posteriorly 35
35. Head only slightly broader than long, also pronotum relatively long; body brown, legs partly yellowish (? a form of *Camarothorax equicollis*)
 — Head obviously shorter than broad, its genae converging; pronotum transverse; body yellow *Camarothorax longimucro*

APTEROUS MALES

36. Solenogastrous i.e., the last four or five gastral segments tubularly lengthened; antenna reduced to five or six segments (Agaoninae) 37
 — Last gastral segments not tubularly lengthened; antenna consisting of at least ten segments 39

37. Antennae situated in a common groove (fig. 7), the club slender, not much wider than the funicle (fig. 10) *Elisabethiella stuckenbergi*
 — Antennae situated in separate sockets, the club much wider than the funicle (fig. 13) (*Alfonsiella*) 38
38. Head rather wide in front, the width just behind the eyes little smaller than the maximum width. General aspect, fig. 13 *Alfonsiella brongersmai*
 — Head distinctly narrowing frontad, the width just behind the eyes four-fifths of the maximum width *Alfonsiella longiscapa*
39. Antennae inserted high on face, at the upper ocular line, their toruli wide apart; tarsi 4-segmented, antennae 10-segmented (*Otitesellinae*)
 *Otitesalla tsamvi*
 — Antennae inserted near to mouth, below lower ocular line; tarsi 5-segmented, antennae consisting of 11 or 12 segments (*Sycoryctinae*) 40
40. Segments of antennal flagellum normal, gradually changing in shape; two basal segments of hind tarsus strongly expanded dorsally; hypostomal margin of characteristic shape: deeply incised between sublateral lobes (fig. 49) (*Philotrypesini*) *Philotrypesis parca*
 — Flagellum with partly alternating larger and smaller segments, especially second funicular segments always smaller than the first; hind tarsus at most with first segment expanded; hypostomal margin at most moderately emarginate (or straight) (*Sycoryctini*) 41
41. Tarsi with enlarged last segment but basal segments small, especially on fore tarsus (fig. 58); antenna 11-segmented *Sycoscapter cornutus*
 — Tarsi different, last segment not greatly enlarged, on hind tarsus first segment distinctly longer than the second; antenna 12-segmented (*Sycoryctes*) 42
42. Head posteriorly with conspicuous cervical shield; head and thorax with abundant pilosity; antennal club usually much darker than the slender funiculus; hind basitarsus at most only moderately broadened
 *Sycoryctus hirtus*
 — Head posteriorly only with the usual raised cross-carina; head and pronotum, apart from usual bristles, nearly glabrous; funicular segments of antenna rather wide, club less distinctly set off, pale; hind basitarsus often greatly enlarged *Sycoryctes remus*

AGAONINAE

In the present material, three species of Agaoninae are represented, viz., two of *Alfonsiella* Waterston and one of *Elisabethiella* Grandi. Evidently, either can act as a pollinator, but the true relationships are not understood.

A key to the African genera of the Agaonidae was published by Wiebes (1974a: 34—36), one to the species of *Elisabethiella* in the same paper (p. 30—31). The species here treated is a member of the species group of *E. enriquesi* (Grandi), with which it will be compared in the description below.

Elisabethiella stuckenbergi (Grandi)

(figs. 5, 7—12; pl. 1 fig. 1, 3)

Blastophaga (*Elisabethiella*) *stuckenbergi* Grandi, 1955: 85—87. Holotype ♀, South Africa: Grahamstown (LEB) [examined].

Female. — Length of the head, thorax and gaster ca. 1.4 mm. Colour dark brown to blackish, the antennal scape and the tarsi of the legs lighter.

Head as long as wide across the compound eyes; the eye as long as the cheek. Mandible with five ventral ridges, two apical teeth and two glands; the append-



Figs. 7—12. *Elisabethiella stuckenbergi* (Grandi), female (12) and male (7—11). 7, head and thorax; 8, fore tibia and tarsus; 9, hind tibia and tarsus; 10, left antenna, ventral aspect; 11, left mandible, ventral aspect; 12, hypopygium. Figs. 13—15. *Alfonsiella*, sketches of: 13, male of *A. brongersmai* Wiebes; 14, female of *A. brongersmai* Wiebes; 15, female head and part of thorax of *A. longiscapa* Joseph.

age four times as long as wide, with about twenty rows of ten to twelve denticulations (except for the proximal and distal rows, which have less). Labium with two apical setae, the maxilla with two subapicals. Antenna: the scape three times as long as the rotundate pedicel; the segments, from the fifth onwards, with rather long sensilla covering the whole length of the segment.

Thorax with large mesosternal pollen pockets; shallow coxal corbiculae and a distinct comb. Fore tibia with an apical comb of three teeth and with one ventral tooth and a spur; the tarsal segments approximately in ratio 7 : 3 : 3 : 3 : 6. Mid leg: tarsal ratio 4 : 3 : 3 : 3 : 4. Hind tibia with two bidentate antiaxial and a slender, simple axial teeth; the tarsal segments approximately in ratio 8 : 4 : 3 : 2 : 5. Fore wing (ca. 2 : 1) 1.3 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 10 : 2 : 3 : 4; the hind wing (4 : 1) 0.7 mm long.

Gaster: the hypopygium (fig. 12) has a rather short spine with a blunt apex (unknown for *E. enriquesi*). The ovipositor is as long as the body, over two times as long as the gaster (27 : 13).

Male. — Length of the head and thorax ca. 0.9 mm. Colour yellow-brown.

Head (fig. 7) as long as wide; the eye approximately one-fifth of the length of the head. The dorsal surface, especially in the anterior third, has rather stout spines directed backwards. Mandible (fig. 11) with one apical tooth and with one gland; other mouthparts atrophied. Antennae (fig. 10) situated in a common groove; there are five free segments (formula 1121), the third and fourth of which are annuliform; the club is more than twice as long as wide (20 : 9).

Thorax, fig. 7. The pronotum has a distinct collar, the sclerite itself is shorter than the combined lengths of the posterior sclerites (10 : 11) and longer than wide posteriorly (20 : 19). As seen from the lateral indentations, the meso-, metanotum and propodeum are subequal in length; the mesonotum is wider than the metanotum (19 : 14), the propodeum is narrower (12). The spiracles occupy one-third of the length of the propodeum. Fore tibia (fig. 8) with three teeth in a dorso-apical crest and two short conical spines on the dorsal margin, a bidentate ventral apex; the tarsal segments all distinctly separate, approximately in ratio 8 : 3 : 2 : 1 : 7, the first and second with two and one axial cones, respectively. Mid leg: tarsal ratio 6 : 5 : 6 : 5 : 7. Hind tibia (fig. 9) with a bidentate apical crest at the antiaxial disk and a faintly bicuspidate tooth axially (Grandi mentioned a tridentate crest for *E. enriquesi*, which must have been the bidentate crest and the axial tooth seen as one); the tarsal segments approximately in ratio 8 : 5 : 4 : 5 : 10, the basitarsus has four conical spines in two rows (in one line in *E. enriquesi*) and the second has one ventral cone.

Gaster: the genitalia simple.

Material. — Series ♀♂, Zimbabwe-Rhodesia: Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, xii.1976 (A. Watsham); Salisbury, ex *Ficus burkei*, series ♀♂, ii-v.1977 (A. Watsham). Zambia: Kafue National Park, Ngoma, ex *Ficus burkei*, 6 ♂, 8.xii.1977 (M. G. Bingham, no. 2465); Lusaka, Chelston School, ex *Ficus burkei*, 7.i.1979 (M. G. Bingham, no. 2472); Chipata Golf Course, ex *Ficus burkei*, 14 ♀, 11.i.1979 (M. G. Bingham, no. 2474); Lusaka,

Cathedral of the Holy Cross, ex *Ficus burkei*, 50 ♀ 50 ♂, 16.ii.1979 (M. G. Bingham, no. 2490). The material is deposited in the RMNH, Leiden, some duplicates are in the BMNH, London and in the Watsham Collection.

Comments. — The number of crenulations in the transverse rows on the mandibular appendage was not clear from Grandi's description of the female; now, the data used in my key (Wiebes, 1974a: 31) prove to be incorrect. The only differential character that remains with the female of *E. enriquesi* is the longer head. The male, too, should be compared with *E. enriquesi* and also with *E. allotriozoonoides* (Grandi), to which Grandi referred when describing *E. enriquesi*. The following couplets have to be inserted into my key to accomodate for the species mentioned.

1. Female: the antennal pedicel angular in outline, longer than wide. Male: the head distinctly longer than wide (7 : 6), the pronotum as long as the composite posterior sclerite. Eritrea, ex *Ficus* spec. *allotriozoonoides*
— Female: the antennal pedicel rotundate in outline. Male: the head, if at all, only little longer than wide, the pronotum shorter than the posterior sclerite.. 2
2. Female: the head distinctly shorter than wide across the compound eyes (6 : 7). Male: the fore tibia without conical spines on the dorsal margin; the second to fifth tarsal segments fused. Angola, ex *Ficus* spec. *enriquesi*
— Female: the head as long as wide. Male: the fore tibia with two short conical spines on the dorsal margin; all tarsal segments free. South Africa, Rhodesia and Zambia, ex *Ficus burkei* *stuckenbergi*

Alfonsiella Waterston

There are four described species of *Alfonsiella*, mainly known from light catches. In the present material (which is retained in the RMNH, Leiden for further revision) two species are represented, viz., *A. brongersmai* Wiebes and *A. longiscapa* Joseph, but in different samples. The two species are recognizable by the following characters (Wiebes, 1972).

Female. — Length of the head, thorax and gaster 1—2 mm. Colour yellowish.

Head scarcely longer than wide in *A. brongersmai* (fig. 14), distinctly longer than wide in *A. longiscapa* (fig. 15); the compound eye $1\frac{1}{2}$ —2 times as long as the cheek. Two ocelli. Mandibular appendage with about twenty (*A. brongersmai*) or thirty-five ventral rows of teeth (*A. longiscapa*). Antenna: the scape with an apical process in *A. longiscapa*, without such a process in *A. brongersmai*; the third segments rather simple, the funicular sensoria very long and flexible.

Thorax with mesosternal pollen pockets, and also the fore coxa with a corbiculum. Fore tibia with two dorso-apical teeth and one ventral. Hind tibia with two ventral spurs. Postmarginal vein of fore wing as long or half as long as the stigmal (*A. longiscapa* and *brongersmai*, respectively).

Gaster: the ovipositor about as long as the gaster.

Male. — Length of head and thorax 1 mm. Colour yellowish, but the head may be darker, especially the large mandibles; the mid femur and tibia dark and setose.

Head little longer than wide in *A. brongersmai* (fig. 13), distinctly longer than wide (5 : 4) in *A. longiscapa*; with rather large compound eyes, one-quarter of the length of the head. Mandible heavy, triangular in lateral aspect. Antenna six-segmented (formula 1131).

Thorax consisting of two sclerites. Fore tibia with two dorsal hook-like teeth and one simple ventral, the dorsal edge with conical spines; the tarsus oligomeric. Mid leg strikingly darker than the other legs, the femur and tibia setose. Hind tibia: two ventral spurs, the dorsal margin with conical spines.

Gaster: genitalia simple.

***Alfonsiella brongersmai* Wiebes**

(figs. 13, 14)

Alfonsiella brongersmai Wiebes, 1972: 326. Holotype ♀, Kenia: Nairobi (RMNH, Leiden) [examined].

Material. — Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, 2 ♂, ii.1977 (A. Watsham). Zambia: Chipata, ex *Ficus petersii*, 14 ♀ 6♂, 11.i.1979 (M. G. Bingham, no. 2475); Lusaka, Cathedral of the Holy Cross, ex *Ficus burkei*, 1 ♀, 16.ii.1979 (M. G. Bingham, no. 2490).

***Alfonsiella longiscapa* Joseph**

(fig. 15)

Alfonsiella longiscapa Joseph, 1959: 30. Holotype ♀, Guinea: Mts. Nimba (MNHN, Paris) [examined]; Wiebes, 1972: 328—330.

Material. — Zambia: Luapula Prov., Mununshi Banana Estate, ex *Ficus* cf. *burkei*, 23 ♀ 5 ♂, 9.xii.1978 (M. G. Bingham, no. 2471).

SYCORYCTINI

The Sycoecinae have alate males, and females modified for penetrating the fig ostiole. They are easily distinguished by the wing veins in that the marginal is just longer than the stigmal, and thickened; the postmarginal is subequal to the stigmal but very sharply tapering (Hill, 1967: 98).

Grandi (1955: 101, nota) concluded when making his key to the genera of the Sycoecinae (Sycophagini in his sense, pro parte), that the classification of this group is still unstable. Even now *Lipothymus* Grandi and *Eujacobsonia* Grandi are allocated to the Otitesellinae and *Sycophaga* Westwood to the Sycophagini s. str. (Wiebes, 1966a), there still is some ambiguity in the definitions of *Crossogaster* Mayr and *Phagoblastus* Grandi. Six species are included: *Crossogaster triformis* Mayr (1885: 189—192, figs. 20—22; redescribed by Grandi, 1928: 203—206, figs. xlii-xliii, the apterous male excluded), *Crossogaster silvestrii* Grandi (1916: 253—264, figs. xli-xliv), *Crossogaster atrata* Masi (1917: 125—126, fig. 3), *Crossogaster odorans* Wiebes, spec. nov., described below, *Phagoblastus barbarus* Grandi (1955: 102—106, figs. viii-ix), the male described below, and *Phagoblastus liodontus* Wiebes (1979b: 397—400, figs. 20—37).

It appears that there are three species groups, as follows: *Crossogaster* s. str., species *C. triformis* and *odorans*. — Epistomal margin entire; antenna with one anellus; labial palpus consisting of one segment, the maxillary one- or indistinctly two-segmented¹⁾; female fore tibia with a dorso-apical, bidentate hook; stigma of the eighth urotergite especially in the female large, ovoid.

Phagoblastus, species *P. barbarus* and *liodontus*. — Epistomal margin entire; antenna with two anelli; labial palpus consisting of two segments, the maxillary of three; female fore tibia with a row of teeth.

Crossogaster, group of *C. silvestrii* and *atrata*. — Epistomal margin cleft in the middle; antenna with two anelli; labial palpus of *silvestrii* consisting of one segment, maxillary of two (*atrata*: 2, 3); female fore tibia with a row of conical spines.

Table 2. Host relations of *Crossogaster* and *Phagoblastus*.

<i>Ficus</i>	<i>Crossogaster</i>	<i>Phagoblastus</i>	<i>Elisabethiella</i>	<i>Allotriozone</i>	references
<i>vasta</i>	<i>triformis</i> ¹⁾		<i>socotrensis</i>		Wiebes, 1977b: 210
<i>burkei</i>	<i>odorans</i>	<i>barbarus</i>	<i>stuckenbergi</i>		present paper
<i>petersii</i>		<i>barbarus</i>	<i>stuckenbergi</i>		Grandi, 1955: 106
<i>leprieuri</i>		<i>liodontus</i>			Wiebes, 1979b: 397
<i>reflexa</i>		spec. ²⁾	<i>reflexa</i>		Wiebes, 1975: 234
<i>vogelii</i>	<i>silvestrii</i> ³⁾	spec. ⁴⁾		<i>heterandromorphum</i>	Grandi, 1916: 264
<i>baroni</i>	spec. ⁵⁾			<i>heterandromorphum</i>	Wiebes, 1974c: 140
<i>nautarum</i>	cf. <i>atratus</i>			<i>heterandromorphum</i>	Wiebes, 1975: 233

¹⁾ 8 ♀, Ethiopia, leg. Friis no. 2263 (RMNH, Leiden, no. 2905).

²⁾ *Crossogaster* spec, Wiebes, 1975.

³⁾ Host record inferred from the locality data.

⁴⁾ Newton & Lomo, 1979; the identity has to be checked.

⁵⁾ Series ♀ ♂, Madagascar, leg. L. Blommers (RMNH, Leiden, no. 2363).

Crossogaster s. str. and *Phagoblastus* are associated with Agaonidae of the genus *Elisabethiella*, as is apparent from the records listed in table 2. It should be noted that also *Philocaenus* Grandi may be found in *Elisabethiella*-figs. The two aberrant species of *Crossogaster* seem to be associated with Agaonidae of the genus *Allotriozone* Grandi. The species may be distinguished by the following key.

Key to the species of *Crossogaster* and *Phagoblastus*

1. Epistomal margin cleft in the middle 2
- Epistomal margin entire 3
2. Labial palpus consisting of two segments, the maxillary of three. Male unknown. Seychelles and Aldabra, ex *Ficus nautarum* Bak *atrata*
- Labial palpus consisting of one segment, the maxillary of two. Senegal, ex *Ficus vogelii* Miq *silvestrii*

¹⁾ Grandi (1928: 204, fig. xlii, 3) corrected Mayr (1885: 189) and stated that the maxillary palpus has two segments. In my material, from *Ficus vasta* Forsk. as well as from *F. burkei*, the basal segment of the maxillary palpus is short, in some instances merely consisting of a sclerotization of the connective membrane.

3. Antenna with one anellus. Female fore tibia with a dorso-apical, bidentate hook 4
- Antenna with two anelli. Female fore tibia with a comb of three to seven conical teeth 5
4. Female: antenna with sensilla linearia. Male: the hind tibia without very stout spines. Socotra, ex *Ficus vasta* Forsk *triformis*
- Female: antenna with long sensilla chaetica. Male: hind tibia rather heavily armed with dorsal and ventral rows of spines. Rhodesia and Zambia, ex *Ficus burkei* *odorans*
5. Female: mandible smooth, without teeth except at the apex. Male: the compound eye more than twice as long as the cheek (12 : 5). Gabon, ex *Ficus lepieuri* Miq. *liodontus*
- Female: mandible with a row of ventral teeth. Male: the compound eye not quite twice as long as the cheek. South Africa, Rhodesia and Zambia, ex *Ficus burkei* and *petersii* *barbarus*

***Crossogaster odorans* Wiebes, spec. nov.**

(figs. 16—24, 29—36; pl. 1 figs. 2, 4)

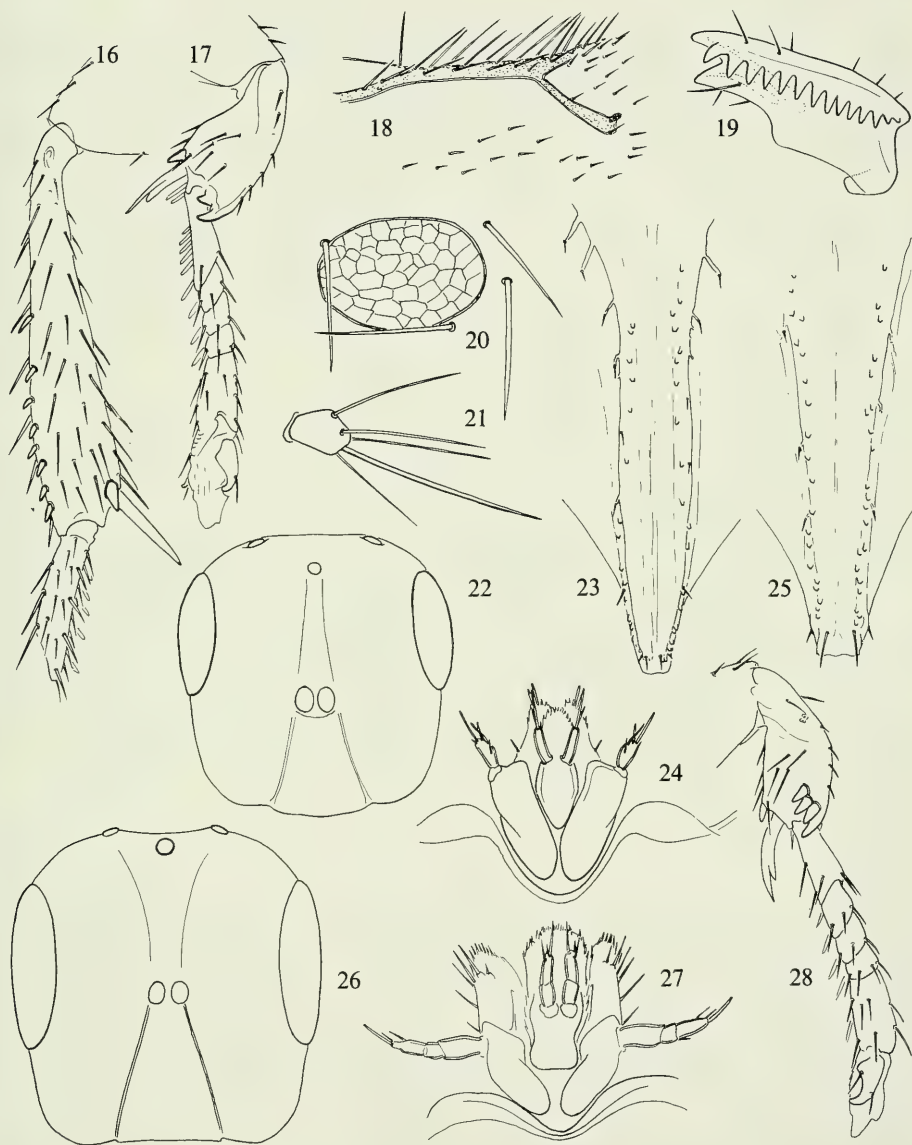
Female. — Length of the head, thorax and gaster 1.3—1.6 mm, the ovipositor valves ca. 0.15 mm long. Colour dark, especially the head and thorax, the gaster and the greater part of the legs lighter.

Head (fig. 22) about as long as wide across the compound eyes; the eye almost half as long as the head (5 : 11), slightly longer than the cheek (5 : 4). Three ocelli. The face has a triangular median impression, with the antennal toruli about half way between the epistomal margin and the median ocellus. Epistomal margin weakly convex. Antennal toruli close together. Mandible (fig. 19) with two apical teeth, two glands, and with a longitudinal row of approximately fourteen small teeth at the ventral surface. Labium and maxillae (fig. 24): the palpi unisegmented. Antenna (fig. 29) eleven-segmented, formula 1115(3); the scape five times as long as wide, 2½ times as long as the pedicel; the funicular segments and the club have long rod-like sensilla in an irregular row of about ten per segment (in some instances the sensilla are somewhat longer than drawn in the figure).

Thorax glabrous except for some long setae on the pronotum (which is wider than long, 5 : 4), the scutum (with complete parapsidal furrows) and the scutellum; and with a row of short setae on the mesosternum running from slightly behind the wing-basis almost to the coxal cavity of the mid leg¹). Fore leg (fig. 17): the tibia has long setae, the armature consists of a dorso-apical bidentate hook, one ventral cone, and a bifid spur, next to two peg-like spines at the axial apex; the tarsal segments approximately in ratio 7 : 2 : 2 : 2 : 6, with peg-like spines at the axial surface. Mid leg: tarsal ratio 12 : 7 : 6 : 5 : 6. Hind leg (fig. 16): the tibia heavily armed with setae and about eight conical spines

¹) I mentioned such a patch of setae for *Phagoblastus liodontus* Wiebes (1979b: 397, 399); it may be adaptive to (topocentric) pollination.

along the dorsal margin, one robust cone and a long spur-like spine in the ventral angle; the tarsal segments approximately in ratio 12 : 8 : 7 : 6 : 7, with many ventral and axial spines. Fore wing (7 : 3) 1.1 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 16 : 7 : 4 : 2



Figs. 16—24. *Crossogaster odorans* Wiebes, spec. nov., female holotype. 16, hind tibia and metatarsus; 17, fore tibia and tarsus; 18, venation of fore wing, detail; 19, mandible, ventral aspect; 20, stigma of eighth urotergite; 21, pygostyle; 22, head; 23, hypopygium; 24, mouthparts. Figs. 25—28. *Phagoblastus barbarus* Grandi, female. 25, hypopygium; 26, head; 27, mouthparts; 28, fore tibia and tarsus.

(fig. 18), the membrane glabrous in the proximal third, with small microtrichia distally; hind wing (4 : 1) 0.9 mm long.

Gaster. The posterior edges of the segments crenulate. Hypopygium (fig. 23) with short setae and small warts along the arms of the V, the spine short. Stigma (fig. 20) of the eighth urotergite large, ovoid in outline; the pygostyle (fig. 21) with five long setae.

Male. — Length of the head, thorax and gaster, ca. 1.5 mm. Colour yellowish, the long setae on the head, thorax and gaster blackish.

Head (fig. 31) about as long as wide across the compound eyes; the eye almost half as long as the head (5 : 11), distinctly longer than the cheek (5 : 3). Three ocelli. The antennal toruli situated just below an imaginary line connecting the lower rims of the eyes. Clypeus slightly impressed, the epistomal margin weakly convex. Mandible (fig. 36) with two teeth, the subapical of which situated on the outer side; two glands. Maxillary palpi two-segmented (1 : 5), labial palpi consisting of one segment, which is as long as the apical one of the maxillary palpi. Antenna (fig. 30) eleven-segmented, formula 1115(3); the scape five times as long as wide, more than twice as long as the pedicel (21 : 9); the club (segments in ratio 2 : 3 : 4) much wider than the funicle.

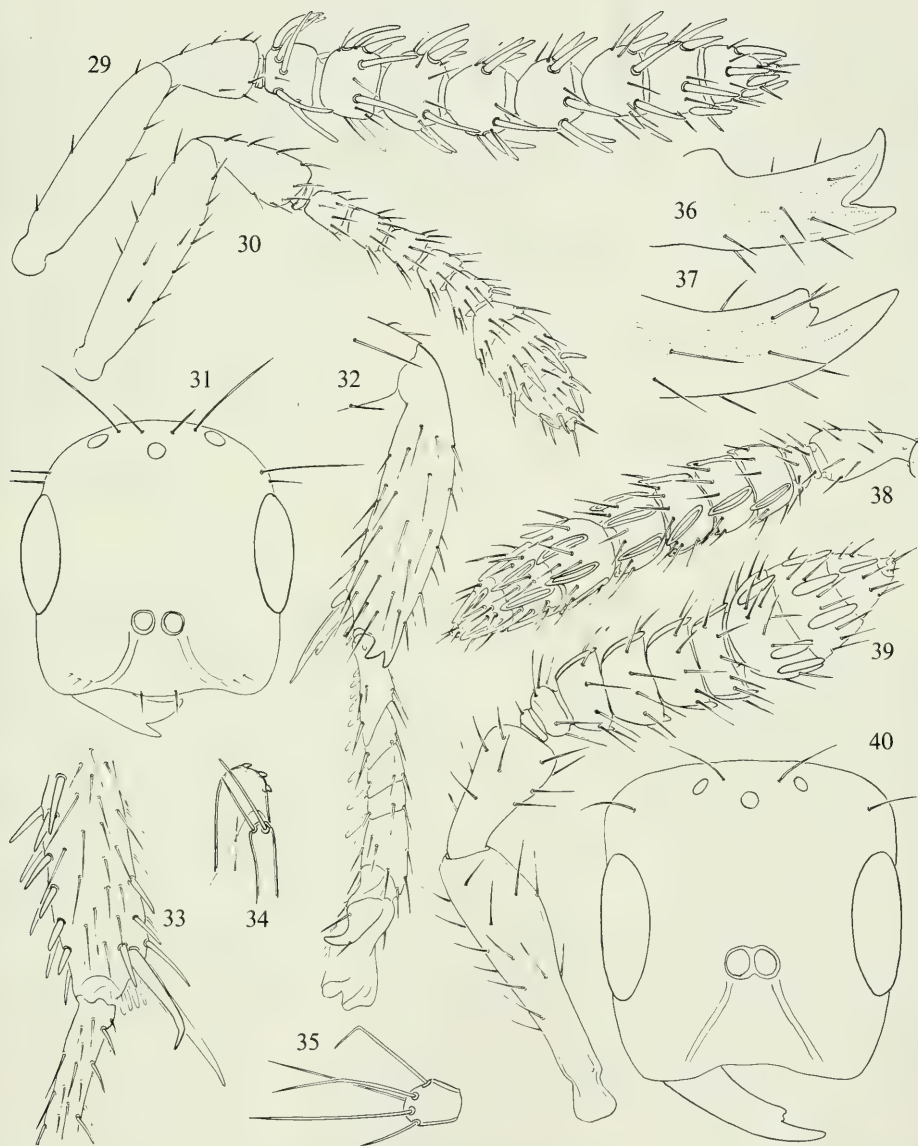
Thorax with a rather long pronotum (length: width, 3 : 5) and short mesoscutum (5 : 12), with short parapsidal furrows; the scutellum distinctly transverse (8 : 5), the propodeum wide (1 : 3). Fore leg (fig. 32): the tibia with two short dorso-apical teeth, one ventral conical spine and one bifid spur; axially, there are some slender spines next to the spur; the tarsal segments approximately in ratio 4 : 1 : 1 : 1 : 2, with peg-like spines on the axial surface. Mid leg: tarsal ratio 12 : 7 : 6 : 5 : 8. Hind leg (fig. 33): the tibia rather heavily armed with dorsal and ventral rows of spines and with two long ventral spurs; the tarsal segments approximately in ratio 15 : 9 : 7 : 5 : 9, with many setae and spines. Wings much as in the female, the submarginal, marginal, stigmal and postmarginal veins of the fore wing (12 : 5, 1.2 mm long) approximately in ratio 16 : 6 : 5 : 2; the hind wing (5 : 1) 0.9 mm long.

Gaster. The pygostyle (fig. 35) with five setae; the claspers of the genitalia (fig. 34) with three claws.

Type material. — Holotype ♀ (slide-mounted), Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in RMNH, Leiden (no. 2970). Paratypes: series ♀ ♂ and two mating pairs, same data as holotype (coll. dates ii-iv. 1977); Chishawasha nr. Salisbury, 15 ♀ 10♂, vii, xi.1974, i, iv, vi.1975, vii.1976, i.1977; Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, xii.1976 (A. Watsham). Zambia: Kafue National Park, Ngoma, ex *Ficus burkei*, 6♀, 8.xii.1977 (M. G. Bingham no. 2465); Chipata Golf Course, ex *Ficus burkei*, 1 ♂, 11.i.1979 (M. G. Bingham, no 2474). The material is deposited in the RMNH, Leiden, some duplicates are in the BMNH, London and in the Watsham Collection.

Comments. — Compared with *Crossogaster triformis* Mayr, the new species

can at once be distinguished by the sensilla of the female antenna. The male of *C. triformis* was not fully described and for that reason cannot be compared with the present sample.



Figs. 29—36. *Crossogaster odorans* Wiebes, spec. nov., female holotype (29) and male (30—36). 29, female antenna, axial aspect; 30, male antenna, axial aspect; 31, head; 32, fore tibia and tarsus; 33, apex of hind tibia, and metatarsus; 34, armature of genitalia; 35, pygostyle; 36, apex of mandible. Figs. 37—40. *Phagoblastus barbarus* Grandi, female (38) and male (37, 39, 40). 37, apex of mandible; 38, female antenna, antiaxial aspect; 39, male antenna, axial aspect; 40, head.

Phagoblastus barbarus Grandi

(figs. 25—28, 37—40)

Phagoblastus barbarus Grandi, 1955: 102—106. Holotype ♀, South Africa: Grahamstown (LEB) [examined].

Female. — Length of the head, thorax and gaster ca. 1.8 mm, the ovipositor valves ca. 0.2 mm long. Colour much as in *Crossogaster odorans*.

Head (fig. 26) variable, its length equal to its width in large specimens, up to distinctly larger than the width (11 : 10) in more slender examples; the eye more than half as long as the head (13 : 25), almost twice as long as the cheek (13 : 7). Mandible much as in fig. 19; the two segments of the labial palpus approximately in ratio 3 : 4, the three of the maxillary palpus 5 : 2 : 4 (fig. 27). Antenna (fig. 38), formula 1125(3): the scape six times as long as wide, 2½ times as long as the pedicel; the funicular segments with few linear sensilla.

Thorax, differential characters with *Crossogaster odorans*: fore tibia (fig. 28) with four or five teeth in the dorsal comb (seven in Grandi's specimens), the tarsal segments approximately in ratio 6 : 3 : 2 : 2 : 6. Mid leg: tarsal ratio 4 : 3 : 3 : 2 : 3. Hind tibia with a row of five or six conical spines along the dorsal margin and one conical spine next to the long spur at the ventral apex, much as in *Crossogaster odorans* (fig. 16); the tarsal ratio approximately 8 : 7 : 5 : 5 : 6.

Gaster. Hypopygium (fig. 25) with a short, rather wide spine. Stigma of the eighth urotergite approximately one-third of that of *Crossogaster odorans*; the pygostyle with four long setae.

Male. — The male was not known to Grandi; it is here compared to that of *Crossogaster odorans*, described above. Length of the head, thorax and gaster ca. 1.7 mm; the colour darker than in *Crossogaster odorans*. Head (fig. 40) as long as wide across the compound eyes, which are not quite half as long as the head (11 : 24) and much longer than the cheek (5 : 3). The antennal toruli are situated above an imaginary line connecting the lower rims of the eyes; the epistomal margin is almost straight. Mandible (fig. 37): the subapical tooth truncate at the tip or even bicuspidate, situated on the inner side of the large apical tooth; two glands. Maxillary palpus three-segmented (7 : 3 : 6), labial palpus two-segmented (9 : 11). Antenna (fig. 39), formula 1125(3); the scape slightly expanded distad, the anelli unequal (2 : 5), the funicular segments transverse, with lateral sensilla, the club wider, with more sensilla.

Thorax. The armature of the legs similar to that in *Crossogaster odorans*, the tarsal ratios as follows: fore leg, 3 : 1 : 1 : 1 : 3; mid leg, 10 : 7 : 6 : 4 : 8; hind leg, 13 : 9 : 7 : 5 : 9.

Gaster. Claspers of the genitalia with four or five claws.

Material. — Series ♀♂, Zimbabwe-Rhodesia: Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, xii.1976 (A. Watsham); Salisbury, ex *Ficus burkei*, series ♀♂, ii.1977 (A. Watsham). Zambia: Chipata, ex *Ficus petersii*, 6 ♀ 2 ♂, 11.i.1979 (M. G. Bingham, no. 2475). The material is deposited in the RMNH, Leiden, some duplicates are in the BMNH, London and in the Watsham Collection.

Comments. — Although the two specimens from Grandi's original series differ from the present specimens in the number of teeth on the fore tibia (seven versus four or five), I could not find any other characters warranting a specific distinction from *Phagoblastus barbarus*.

PHILOTRYPESINI

The Philotrypesini form a group of fig wasps immediately recognized by the tubularly lengthened eighth and ninth urotergites of the female and by the deeply emarginate hypostomal edge of the male. There are some twenty known species of *Philotrypesis* Förster (revised by Grandi, 1930), and one of *Philotrypomorpha* Abdurahiman & Joseph (1976) from India. In general, the differences between the species are rather slight, especially in the female sex, while in the male sex the polymorphism may make differentiation and identification difficult. *Philotrypesis* appears to be associated with species of all sections of *Ficus*. There are five species of *Philotrypesis* known from Africa. The present species cannot be confused with two of those because they have the sensilla of the female antenna situated in several rows per segment (*P. africana* Grandi, *longicornis* Grandi). From the other three viz., *P. erythraea* Grandi, *finitimorum* Wiebes and *selenetica* Grandi, it can be distinguished by the characters used in the following key.

Key to some African species of *Philotrypesis*

1. Female: setae on the antennal funicle dispersed over the segment. Male: hind basitarsus 3—4 times as long as the second segment 2
- Female: setae on the antennal funicle situated at the base of the segment. Male: hind basitarsus not quite twice as long as the second segment 3
2. Female: funicular segments of the antenna relatively short, e.g., the first only slightly longer than wide. Hind tibia with four conical spines in the dorso-apical corner. Male unknown. Guinea, ex *Ficus vogelii* Miq. *selenetica*
- Female: funicular segments of the antenna longer, e.g., the first 1½ times as long as wide. Hind tibia with two conical spines in the dorso-apical corner. Sierra Leone, ex *Ficus* cf. *eriobotryoides* K. & B. *finitimorum*
3. Female: the stigmal vein half as long as the postmarginal. Male: fore tibia with two stout spines proximad of the ventral spur; mid tibia with conical spines along the dorsal margin; hind femur without apical spines, the tibia without stout spines at one-third of its length. Eritrea, ex *Ficus* spec. *erythraea*
- Female: the stigmal vein one-third of the length of the postmarginal. Male: fore tibia with three stout spines proximad of the ventral spur; mid tibia without a row of dorsal conical spines; hind femur with two spines at the dorsal apex, the tibia with two stout spines at one-third of its length (fig. 47). Rhodesia and Zambia, ex *Ficus burkei* *parca*

***Philotrypesis parca* Wiebes, spec. nov.**
(figs. 41—57; pl. 2 figs. 1, 2, pl. 3 fig. 1)

Female. — Length of head, thorax and apparent gaster 1.8 mm, the tubular segments and the ovipositor valves ca. 3 mm. Colour yellowish, with black marks on the scutellum and propodeum, and on the dorsum of the gastral tergites.

Head (fig. 42) distinctly shorter than wide across the compound eyes (3 : 4); the compound eye almost two-thirds of the length of the head, $1\frac{1}{2}$ times as long as the cheek. Mandible (fig. 44) with two apical teeth, one of which is truncate; two glands; the labial palpus consisting of two segments (2 : 3), the maxillary (fig. 48) of four (4 : 6 : 3 : 11). Antenna (fig. 41) consisting of thirteen segments, formula 1135(3); the scape is three times as long as the pedicel; the funicular segments about as long as wide, each has one rather regular row of long sensilla and long, basal setae.

Thorax. The tibial armature of the fore leg (figs. 45, 46) consists of three conical antiaxial spines, viz., one ventral and two dorsals, and two slender axial spines next to the ventral spur; the tarsal segments are approximately in ratio 6 : 3 : 3 : 2 : 6. Mid leg: tarsal ratio 8 : 4 : 3 : 2 : 3. Hind leg: the tibial armature (fig. 47) consists of two unequal ventral spurs accompanied by two slender antiaxial spines and a row of axials, and four to six spines at the antiaxial dorsal apex; the tarsal segments are approximately in ratio 11 : 7 : 4 : 3 : 4. Fore wing (5 : 2) 1.3 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 6 : 4 : 1 : 3; the hind wing (4 : 1) 0.8 mm long.

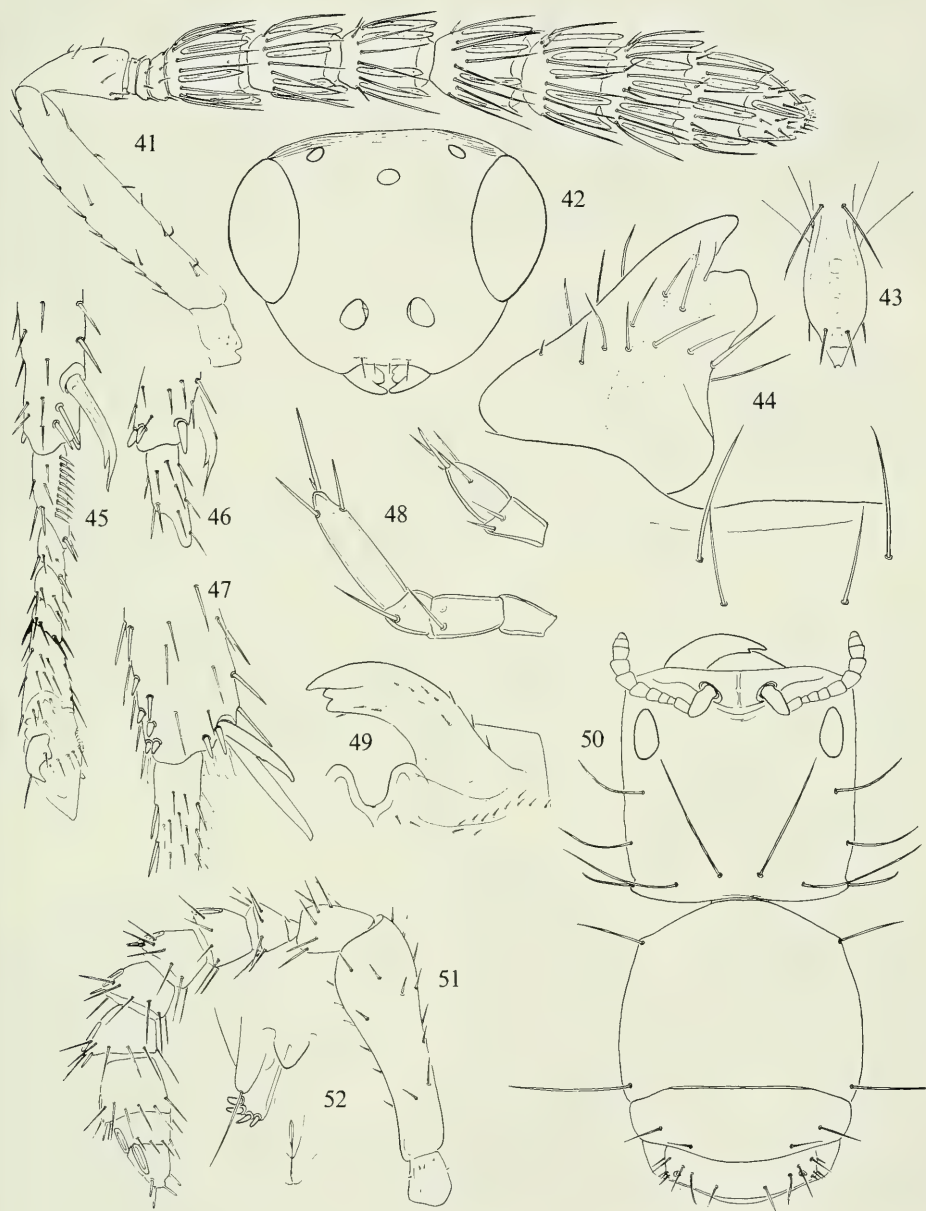
Gaster. The hypopygium (fig. 43) has a short, wide spine. The eighth urotergite is only slightly shorter than the combined lengths of the proximal segments (20 : 23), the ninth is not quite half as long as the eighth (9 : 20). The ovipositor and the valves are distinctly more than twice as long as the eighth and ninth urotergites combined (22 : 9).

Male. — Length of head and thorax 0.8—0.9 mm. Colour yellowish. All specimens studied are eumegetic, acanthocephalous, macrognathous (triodontous) and apterous.

Head (fig. 50) about as long as wide across the compound eyes; the compound eye over one-fifth of the length of the head (2 : 9), longer than the cheek (5 : 3). The head bears long dorsal setae, but no ventrals. The antennal toruli are situated in a shallow depression above the epistomal edge. Mandible falcate, with two glands (fig. 49, also showing the hypostomal edge, so characteristic for all species of *Philotrypesis*), the labial palpus consisting of two segments (11 : 10), the maxillary of four (2 : 2 : 1 : 3). Antenna (fig. 51) eleven-segmented, formula 1115(3); the scape is less than five times as long as the pedicel (23 : 5); the five funicular segments are gradually widening distad, the second to fourth have apical sensilla.

Thorax with the pronotum much longer than the other segments combined (5 : 3), with long setae in the anterior and posterior corners; the mesonotum is (in the middle) more than twice as long as the metanotum and the propodeum taken together. Fore leg: the tibial armature (figs. 53, 56) consists of three stout axial spines, proximad of the ventral spur and one antiaxial, one robust spine at

the axial and antiaxial apices, and one in the dorso-apical angle accompanied by four conical spines; the tarsal segments are approximately in ratio



Figs. 41—52. *Philotrypesis parca* Wiebes, spec. nov., female (41—48) and male holotype (49—52). 41, female antenna, axial aspect; 42, head; 43, apex of hypopygium; 44, clypeus and left mandible, dorsal aspect; 45, apex of fore tibia, and tarsus, axial aspect; 46, do., detail in antiaxial view; 47, apex of hind tibia; 48, mouthparts, palpi; 49, hypostomal margin and right mandible, ventral aspect; 50, head and thorax; 51, male antenna, axial aspect; 52, genitalia.



Figs. 53—57. *Philotrypesis parca* Wiebes, spec. nov., male holotype. 53, apex of fore tibia, and tarsus, axial aspect; 54, apex of mid tibia, and tarsus; 55, hind tibia, axial aspect; 56, apex of fore tibia, and part of tarsus, antiaxial aspect; 57, apex of hind tibia, and tarsus (long setae not fully drawn). Figs. 58—60. *Sycoscapter cornutus* Wiebes, spec. nov., male holotype. 58, fore tibia and tarsus; 59, mid tibia, and part of tarsus; 60, apex of hind tibia, and tarsus.

3 : 1 : 1 : 1 : 15. Mid leg: the tibia (fig. 54) has a small dorsal cone and two more slender ventral spines at the apex (one axial and one antiaxial), the ventral margin has six large spines, the dorsal margin is without the row of conical spines described and figured for all forms of *P. erythraea*; the tarsal segments are approximately in ratio 11 : 4 : 5 : 4 : 24. Hind leg (figs. 55, 57): the femur have two spines, one behind the other, at the dorsal apex; the tibial armature consists of two spines (situated just beyond one-third of the length of the tibia) that are not apparent in *P. erythraea*; some more spines, most of which small and conical, occur along the dorsal margin and at the antiaxial apex; two longer, slender spines accompany the unequal ventral spurs, and three larger spines are situated along the distal third of the ventral margin; the tarsal segments (measured along the dorsal margin) approximately in ratio 8 : 5 : 1 : 1 : 7, the proximal two expanded dorsad, with long setae.

Gaster. The claspers of the genitalia (fig. 52) with four claws.

Type material. — Holotype ♀ (slide-mounted) Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in RMNH, Leiden (no. 2964). Paratypes: series ♀ 5 ♂, same data as holotype; Chishawasha nr. Salisbury, 5 ♀ 5 ♂, 1976, vi.1977. Zambia: Chipata Golf Course, ex *Ficus burkei*, 3 ♀ 4 ♂, 11.i.1979 (M. G. Bingham, no. 2474). The material is deposited in the RMNH, Leiden, some duplicates are in the BMNH, London and in the Watsham Collection.

Comments. — The present material differs only slightly from Grandi's *Philotrypesis erythraea*, just enough — although originally with some doubt — to consider them separate taxa. A similar situation exists with *Elisabethiella stuckenbergi* and *socotrensis* (discussed above) and *Otitesella tsamvi* and *epicarioides* (compared below). For the alate male (?), see below, under *Watshamiella alata*.

SYCORYCTINI

A key to the Indo-Australian genera of this group was published by Wiebes (1966c: 173). Revisionary notes on some were given by Wiebes (1967: 428, *Sycoscapteridea* Ashmead; 1978b: 185—186, *Sycoscapter* Saunders in Westwood). Abdurahiman & Joseph (1975a: 99) added a new genus *Sycorycteridea*, which they compared with *Sycoryctes* Mayr. As a group, the Sycoryctini are recognizable in the female sex by the tubularly lengthened ninth urotergite, which makes the impression that the apparent gaster ends with the eighth segment; the males are mostly apterous, subapterous in some species and, as will be apparent from one of the descriptions below, alate in others. The apterous males can be distinguished at a glance from those of *Philotrypesis* by the straight or almost straight hypostomal edge.

As many samples of fig insects bred from one fig contain several species and genera of Sycoryctini (up to four were recorded by Wiebes, 1966), it is not always easy to correlate the sexes. For the present study mating pairs were available of all species, so as to allow of a certain correlation of males with their females. In

general, the generic classification of the Sycoryctini is still unsatisfactory and this is why I here confine myself to the differentiation of the genera treated in the general key (p. 159).

Sycoscapter Saunders in Westwood

A survey of the species now recognized in the genus *Sycoscapter* was given with a recent redescription of its type-species (Wiebes, 1978): the African species are *S. gibbus* Saunders and *S. montis* Wiebes. The new species now added may be differentiated from its African congeners by the following key. The male sexes are recognizable as a group by the ventral spur of the fore tibia being bifid, instead of simple as in the Indo-Malayan species.

Key to the African species of *Sycoscapter*

1. Female: the fore wing with about fifteen large setae in the marginal-stigmal angle, some ten along the stigmal vein and a few in the wing-apex; the ninth urotergite about six times as long as the apparent gaster. Male: all tarsi consisting of four segments; wing remnant present. Sierra Leone, ex *Ficus* cf. *eriobotryoides* K. & B. *montis*
- Female: the fore wing with thirty or more large setae in the marginal-stigmal angle, and 15—20 along the stigmal vein; the ninth urotergite two to three times as long as the apparent gaster. Male: all tarsi consisting of five segments; no wing remnant 2
2. Female: the fore wing with many setae in the apical part, so as to make the surface distinctly hirsute. Male: the epistomal margin almost straight or with two slightly protruding bulges. Madagascar, ex *Ficus soroceoides* Baker and Réunion, ex *Ficus laterifolia* Vahl *gibbus*
- Female: the fore wing with only a few large setae in the apical part, otherwise glabrous. Male: the epistomal margin distinctly produced into two rather acute lobes. Rhodesia and Zambia, ex *Ficus burkei* and *petersii* *cornutus*

Sycoscapter cornutus Wiebes, spec. nov.

(figs. 58—60, 64—66, 75—76, 83; pl. 2 fig. 3)

Female. — Length of head, thorax and apparent gaster ca. 1.4 mm, the ninth tergite (the “tail”) ca. 2 mm, i.e., $2\frac{1}{2}$ —3 times as long as the apparent gaster. Colour blackish bronze, the basal segments of the legs up to the tibiae brown, sometimes also the dorsal part of the tibiae dark, mostly the tibiae and tarsi yellow.

Head (fig. 65) shorter than wide across the compound eyes (9 : 11), the eye half as long as the head and as long as the cheek. Antennal toruli slightly below the middle of the face; deep scrobes run from the toruli to the median ocellus. Epistomal margin produced into an acute median projection. Mandible with two rather robust apical teeth; two glands; the labial palpus consisting of two segments (4 : 3), the maxillary of four (6 : 7 : 5 : 13). Antenna (fig. 66), formula 1125(3); the scape $2\frac{1}{2}$ times as long as the pedicel; the funicular

segments with one row of long sensilla, and with a basal row of long setae.

Thorax. Fore leg with two dorsal cones and one antiaxial spine on the tibial apex, and with a bifid ventral spur accompanied by a slender spine; the tarsal ratio approximately 5 : 3 : 2 : 2 : 6. Mid leg: tarsal ratio 9 : 5 : 4 : 3 : 5. Hind leg: the tibia with about six to nine small conical spines along the distal two-thirds of the dorsal margin, and one or two short spines in the ventral angle, next to the two spurs; the tarsal segments approximately in ratio 13 : 10 : 5 : 4 : 7. Fore wing (2 : 1) 1.2 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 5 : 4 : 3 : 6, the stigma (fig. 64) boot-shaped; ca. 35 long setae occur in the marginal-stigmal angle, some fifteen on or along the stigmal vein, and a few in the part distad of this vein; hind wing (4 : 1) 0.8 mm long.

Gaster. Hypopygium (fig. 83) with a short and wide spine, and one pair of long setae.

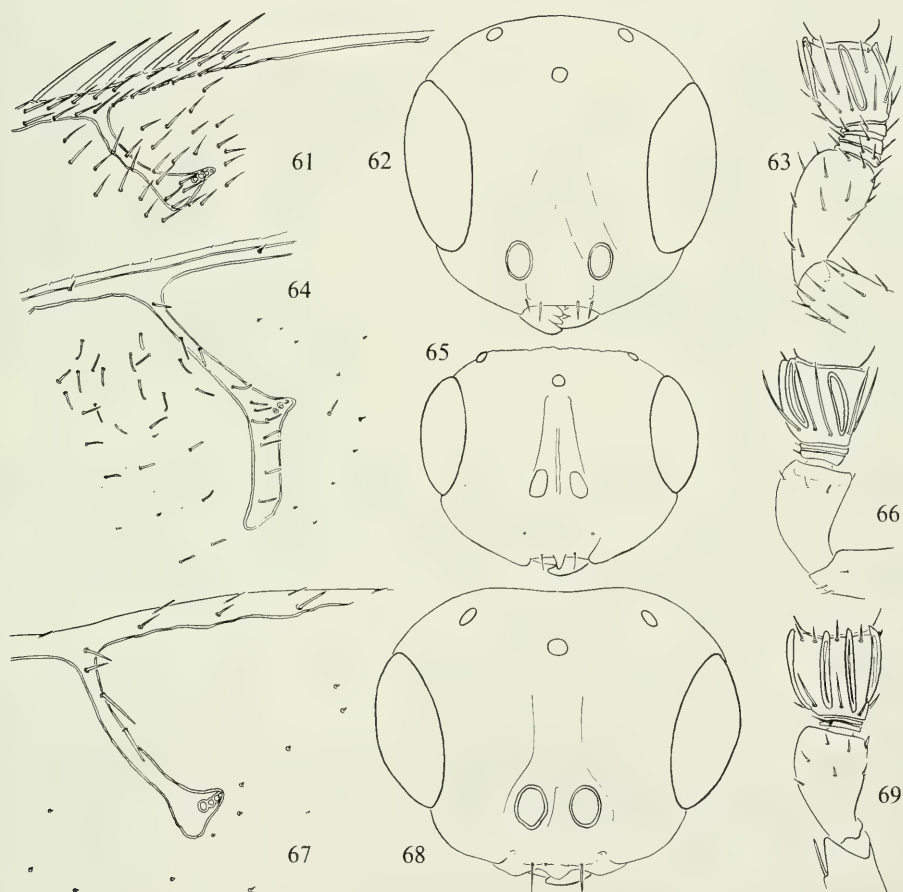


Fig. 61—69. Details of some female *Sycoryctini*: 61—63, *Watshamiella alata* Wiebes, gen. & spec. nov.; 64—66, *Sycoscapter cornutus* Wiebes, spec. nov.; 67—69, *Sycoryctes remus* Wiebes, spec. nov. 61, 64, 67, veins of fore wing; 62, 65, 68, head; 63, 66, 69, scape, anelli and first funicular segment of antenna.

Male. — Length of head and thorax ca. 1.0 mm. Colour and general habitus as in pl. 2 fig. 4, but the epistomal edge with more distinct horn-like projections (fig. 75) and the tarsal segments much shorter, especially those of the fore leg (fig. 58).

Head (fig. 75) longer than wide across the compound eyes (10 : 9); the compound eye one-quarter of the length of the head, about as long as the cheek. The toruli are close together at the epistomal margin, which bears two horn-like projections with a seta on top. Mandible robust, with a serrate molar edge and with two glands; the labial palpus consisting of two segments (2 : 1), the maxillary of four (5 : 6 : 2 : 4). Antenna (fig. 76) eleven-segmented, formula 1115(3); the first and third funicular segments larger than the others, with an apical sensillum (axial in the one, antiaxial in the other); the club segments unequal (3 : 1 : 1), with sensilla on the apical and subapical.

Thorax (fig. 75): the pronotum rather short, $1\frac{1}{2}$ times as wide as long in flattened position, also much wider than the mesonotum (10 : 7) and the posterior tergite (10 : 9) representing the metanotum (the lateral lobes) and the propodeum. All legs bear relatively few tibial spines. The fore coxa has an antiaxial, hyaline edge; except for one long axial, all spines of the fore tibia are fully visible in antiaxial aspect (fig. 58); the ventral spur is rather long and bifid; the five tarsal segments are approximately in length ratio 5 : 1 : 1 : 1 : 17. The mid tibia (fig. 59) is more robust than those of the other Sycoryctini treated here; it bears pairs of ventral spines in the distal half, one simple spur that is as long as the first three tarsi combined, one apical on either side, and up to ten dorsals in the distal half; the tarsal ratio is 3 : 2 : 2 : 2 : 10. The hind tibia (fig. 60) has small spines along two-thirds of the dorsal margin and four longer spines near the ventral apex next to the spur, which is as long as the basitarsus; the tarsal ratio is 3 : 1 : 1 : 1 : 6.

Gaster: the claspers of the genitalia with three or four claws.

Type material. — Holotype ♂ (slide-mounted), Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in RMNH, Leiden (no. 2968). Paratypes: series ♀ ♂ and 13 mating pairs, same data as holotype (coll. dates iii-v.1977); Chishawasha nr. Salisbury, 22 ♀ 28 ♂, vii.1974, v.1975, 1976, i, vi.1977; Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, series ♀ 9 ♂, xii.1976 (A. Watsham). Zambia: Kafue National Park, Ngoma, ex *Ficus burkei*, 4 ♂, 8.xii.1977 (M. G. Bingham, no. 2465); Chipata Golf Course, ex *Ficus burkei*, 1 ♂, 11.i.1979 (M. G. Bingham, no. 2474); Chipata, ex *Ficus petersii*, 2 ♀, 11.i.1979 (M. G. Bingham, no. 2475); Lusaka, Cathedral of the Holy Cross, ex *Ficus burkei*, 19 ♀ series ♂, 16.ii.1979 (M. G. Bingham, no. 2490). The material is deposited in the RMNH, Leiden, some paratypes in BMNH, London and the Watsham Collection.

Sycoryctes Mayr

The type-species of *Sycoryctes*, *S. patellaris* Mayr, originates from Java. It seems that most Indo-Malayan species of the genus are distinct in having long setae on the male hind basitarsus (Mayr, 1885, pl. 13 fig. 30) instead of shorter

setae as in the African species (e.g., fig. 78). Many of the African species are insufficiently known; the new species described below are compared with the following: *S. caelebs* Wiebes, *coccothraustes* Mayr, *lomaensis* Wiebes, *sjoestedti* Mayr, *truncatus* Mayr. Two species are known in the female sex only, viz., *S. dagatiguyi* (Risbec), which has a longer postmarginal vein than the specimens from *Ficus burkei* (where the postmarginal is scarcely longer than the stigmal); and *S. sebertianus* Masi, which seems to be rather larger (6.6 mm versus 5 mm, including the "tail"). In general, the females are difficult to differentiate, as in most cases the descriptions are very short and mostly refer to colour characters. In the present paper, too, the females of the two new species are distinct mainly in colour. The males can be distinguished by the characters used in the following key. Much as the present novelties appear well characterized, the differentiation of some of the others is still unsatisfactory.

Key to the males of African *Sycoryctes*

1. Head and thorax hirsute dorsally 2
- Head and thorax with some long setae, but not hirsute 3
2. Spur of the hind tibia as long as the basitarsus. Cameroons, ex *Ficus* spec. *sjoestedti*
- Spur of the hind tibia reaching to the third tarsal segment. Rhodesia, ex *Ficus burkei* *hirtus*
3. Spur of the hind tibia long, reaching up to the fourth or fifth segment 4
- Spur of the hind tibia much shorter, reaching to the third segment 5
4. Eye small, one-third of the cheek. Basitarsus of the hind leg not expanded. Socotra, ex *Ficus vasta* Vahl *coccothraustes*
- Eye almost as long as the cheek. Basitarsus of the hind leg in most instances distinctly expanded. Rhodesia and Zambia, ex *Ficus burkei* and *petersii*. . . *remus*
5. Head distinctly longer than wide (3 : 2), the lateral margins straight. Sierra Leone, ex *Ficus* cf. *eriobotryoides* K. & B. *lomaensis*
- Head transverse, the lateral margins curved 6
6. Antenna with one anellus. Socotra, ex *Ficus vasta* Vahl *truncatus*
- Antenna with two anelli. Aldabra, ex *Ficus avi-avi* Bl. *caelebs*

Sycoryctes remus Wiebes, spec. nov.

(figs. 67—69, 72—74, 77—79, 84; pl. 2 fig. 4)

Female. — Length of head, thorax and apparent gaster 1.3—1.6 mm, the ninth tergite ca. 2 mm, i.e., 2½ times as long as the apparent gaster. Blackish, also the legs up to and including the tibiae dark; the wings hyaline.

Head (fig. 68) distinctly shorter than wide across the compound eyes (23 : 28), the eye more than half as long as the head (12 : 23) and about twice as long as the cheek. Antennal toruli situated in the lower third of the face, at a distance from the epistomal margin equal to their longitudinal diameter; shallow scrobes run to the median ocellus. Epistomal margin with three wide lobes. Mandible bidentate; two glands; the labial palpus consisting of two segments (4 : 5), the



Figs. 70—71. *Sycoryctes hirtus* Wiebes, spec. nov., male holotype. 70, head and thorax; 71, antenna, axial aspect. Figs. 72—74. *Sycoryctes remus* Wiebes, spec. nov., male holotype. 72, head; 73, lateral lobe of mesothorax, and wing remnant; 74, antenna, axial aspect. Figs. 75—76. *Sycoscapter cornutus* Wiebes, spec. nov., male holotype. 75, head and thorax; 76, antenna, axial aspect.

maxillary of four (2 : 4 : 1 : 5). Antenna (fig. 69), formula 1125(3); the scape three times as long as the pedicel; the funicular segments with one row of long sensilla, and with long basal and shorter apical setae.

Thorax. Fore leg: the tibial armature consisting of two dorso-apical spines and one subapical; ventrally, there is the bifid spur and some accompanying spines, viz., one distal of the spur and two, more slender, proximad; the tarsal segments

approximately in ratio 16 : 8 : 8 : 5 : 12. Mid leg: tarsal ratio 19 : 9 : 6 : 4 : 7. The tibial armature of the hind leg consisting of two unequal spurs and some stout spines along the distal half of the ventral margin: typical is a number of three dark spines and some lighter more proximally; the distal third of the dorsal margin has four or five conical spines and two apicals; the tarsal segments approximately in ratio 22 : 10 : 7 : 4 : 8. Fore wing (5 : 2) 1.25 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 35 : 18 : 9 : 11 (fig. 67), the wing hyaline but for some setae along the veins; hind wing (4 : 1) 0.9 mm long.

Gaster. Hypopygium (fig. 84) broadly rounded, with two setae of medium size at the apex; a patch of two or three setae occur on either side, where the arms of the V appear broken.

Male. — Length of head and thorax 0.7—0.9 mm. General habitus pl. 2 fig. 4; in most specimens, the basitarsus of the hind leg is more distinctly enlarged.

Head (fig. 72) quadrate or slightly transverse, more elongate in small specimens; almost similar in shape to that of *Sycosapter cornutus*, but the epistomal margin less distinctly cornute or even almost straight in the middle; the posterior edge of the head rather sharp, laterally produced into acute angles. Also mandible similar; the segments of the labial palpus approximately in ratio 3 : 2, those of the maxillary palpus 7 : 14 : 4 : 9. Antenna (fig. 74), formula 1125(3).

Thorax much as in *Sycosapter cornutus*, but with a distinct wing remnant (fig. 73). The fore leg (fig. 79) resembles that of *Sycoryctes hirtus*, to be described hereafter, but the dorsal and ventral spines are less in number and there are two apical spines instead of one; the tarsus is more compact, its ratio 5 : 3 : 2 : 2 : 6. The mid leg is long and slender; the tibia (fig. 77) has many spines along the dorsal and ventral edges and a long ventral spur reaching to the third tarsal segment; the tarsal ratio approximately 8 : 4 : 4 : 3 : 9. Hind leg (fig. 78) much like that of *S. hirtus*, but two ventral spines are sometimes situated on a small tibial protuberance, so as to make them very conspicuous, the tibial spur reaches to the fourth tarsal segment; the basitarsus distinctly expanded, the ratio 13 : 4 : 4 : 4 : 9.

Gaster: the claspers of the genitalia wide, with three to five claws.

Type material. — Holotype ♂ (slide-mounted). Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in the RMNH, Leiden (no. 3713). Paratypes: series ♀ ♂ and eight mating pairs, same data as holotype (coll. dates ii-v.1977); Chishawasha nr. Salisbury, 12 ♀ 10 ♂, 1976, vi.1977; Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, series ♀ 15 ♂, xii.1976 (A. Watsham). Zambia: Kafue National Park, Ngoma, ex *Ficus burkei*, 1 ♀ 7 ♂, 8.xii.1977 (M. G. Bingham, no. 2964); Chipata Golf Course, ex *Ficus burkei*, 5 ♀ 3 ♂, 11.i.1979 (M. G. Bingham, no. 2474); Chipata, ex *Ficus petersii*, 2 ♂, 11.ii.1979 (M. G. Bingham, no. 2475); Luapula Prov., Mumunshi Banana Estate, ex *Ficus* cf. *burkei*, 1 ♀, 9.xii.1978 (M. G. Bingham, no. 2471); Lusaka, Cathedral of the Holy Cross, ex *Ficus burkei*, 30 ♀ 24 ♂, 16.ii.1979 (M. G. Bingham, no. 2490). The material is deposited in the RMNH, Leiden, some paratypes are in the BMNH, London and in the Watsham Collection.

***Sycoryctes hirtus* Wiebes, spec. nov.**
(figs. 70, 71, 80, 81)

Female. — Length of head, thorax and apparent gaster ca. 1.5 mm, the ninth tergite ca. 2.5 mm long, i.e., three times as long as the apparent gaster. Blackish as in *S. remus*, but more dull, the legs from the femora onwards yellowish. In all morphological characters this species very much resembles *Sycoryctes remus*, but the number of ventral spines on the hind tibia tends to be larger (up to six) and there usually also are more dorsal spines (six to eight). In some of the samples I could not identify all female specimens with any certainty.

Male. — Length of head and thorax 0.9—1.0 mm. General habitus as in pl. 2 fig. 4, but the head and thorax hirsute dorsally, the antenna slender with a brownish apical knob, and the head with a cervical sclerite (fig. 70); the basitarsus of the hind leg is not expanded.

Head (fig. 70): shape and proportions much as in *Sycoscapter cornutus*, but the epistomal margin straight; the pubescence of the dorsal surface especially distinct in lateral aspect, as a short fur in between the longer setae — the same applies to the thorax. The posterior part of the head is raised in the middle, so as to form a small cervical shield; the lateral angles of the head are slightly produced. The molar teeth of the mandible stout; the segments of the labial palpus approximately in ratio 1 : 1, those of the maxillary palpus 7 : 10 : 3 : 5. Antenna (fig. 71), formula 1125(3).

Thorax, fig. 70. Compared to *Sycoscapter cornutus*, the fore tibia (fig. 80) more slender, with a series of five ventral spines proximad of the bifid spur, one apical spine visible in antiaxial aspect, and three dorsals in the apical third, inserted more axially; the tarsal ratio approximately 6 : 6 : 3 : 2 : 8. Hind tibia (fig. 81): long dorsal spines among a row of cones in the distal two-thirds; ventrally, there are three or four conspicuous spines in the distal third and one long spur, reaching to the third tarsal segment; the tarsal ratio approximately 8 : 3 : 3 : 2 : 5.

Gaster: the claspers of the genitalia with four claws.

Type material. — Holotype ♂ (slide-mounted), Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in RMNH, Leiden (no. 2967). Paratypes: 9 ♀ 7♂ and seven mating pairs, same data as holotype (coll. dates iii-iv.1977); Chishawasha nr. Salisbury, 10 ♀ 4 ♂, vii.1974, 1976, vi.1977; Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, 2 ♀ 3 ♂, xii.1976 (A. Watsham). Zambia: Lusaka, Cathedral of the Holy Cross, ex *Ficus burkei*, 9 ♀ 13 ♂, 16.ii.1979 (M. G. Bingham, no. 2490). The material is deposited in the RMNH, Leiden, some paratypes in the BMNH, London and in the Watsham Collection.

***Watshamiella* Wiebes, gen. nov.**

Type-species: *Watshamiella alata* Wiebes, spec. nov.

Sycoryctini with alate male. Toruli of the antennae widely spaced, situated



Figs. 77—79. *Sycoryctes remus* Wiebes, spec. nov., male holotype. 77, mid tibia and tarsus; 78, apex of hind tibia, and tarsus; 79, fore tibia and tarsus. Figs. 80—81. *Sycoryctes hirtus* Wiebes, spec. nov., male holotype. 80, for tibia and basitarsus; 81, apex of hind tibia, and two tarsal segments. Figs. 82—84. Female hypopygium of some *Sycoryctini*: 82, *Watshamiella alata* Wiebes, gen. & spec. nov.; 83, *Sycoscapter cornutus* Wiebes, spec. nov.; 84, *Sycoryctes remus* Wiebes, spec. nov.

rather close to the epistomal margin, which is straight. Mandible bidentate (most males) or tridentate (females). Antenna with three anelli. Pronotum long; parapsidal furrows complete or almost so. Front femur inflated. Hind basitarsus at least as long as the second and third segments combined. Wings hirsute; the postmarginal vein 2—3 times as long as the stigmal. Gaster shortly petiolate; the ninth urotergite of the female with lateral rows of setae, and with small pygo-style; also the male ninth urotergites with pygo-style.

Comments. — The correlation of the female of *W. alata* with an alate male made me reconsider the generic identification of such males, up to now classified with *Philotrypesis* Förster, viz., *P. anguliceps* (Westwood), *finitimorum* Wiebes and *longicornis* Grandi. The first mentioned appears to be congeneric with the one here treated and thus should be allocated to *Watshamiella*. *P. finitimorum* has short wing remnants and, for the time being, there is no reason to alter its generic status; the wings in *P. longicornis* are longer, but this male, which I did not study myself, is so similar to its female that I prefer to leave it in *Philotrypesis*.

Other species to be compared were up to now classified with *Sycoscapteridea* Ashmead, viz., the female identified with *S. monilifera* by Wiebes (1967) and *S. stilifera* Wiebes (1966). Both are now allocated to *Watshamiella*.

It should be clearly stated that in classifying *Watshamiella* with the Sycoryctini, much weight is given to the structure of the ovipositing organs (Wiebes, 1966a), while the resemblance to the Philotrypesini is neglected e.g., in the three antennal anelli, the situation and number of spines on the legs, the long postmarginal vein of the fore wing. The *Watshamiella*-males, known from their association with the females with which they were found in copula, are very similar to a type of male that I know from the Indo-Malayan region and of which we now also have at least one from *Ficus thonningii*. AW pictured it (pl. III fig. 1), but JTW could not yet study it in any detail: it has a bare strip along the marginal vein, just as *Philotrypesis*-females usually have. Probably, this is an alate male of *Philotrypesis*!

The reclassification of the species mentioned makes necessary some nomenclatorial alterations, as follows:

Watshamiella alata Wiebes, spec. nov., described below.

Watshamiella infida Wiebes, spec. nov., description in Wiebes, 1967: 426, figs. 77—84 (*Sycoscapteridea monilifera* (Westwood), female), 433—434, figs. 102—108 (*Philotrypesis anguliceps* (Westwood), alate male).

Watshamiella stilifera (Wiebes, 1966c), nov. comb.

These species may be recognized by using the following key.

Key to the species of *Watshamiella*

1. Funicular segments of the antenna distinctly longer than wide, with about two (sometimes irregular) rows of sensilla. Male unknown. North Borneo, ex *Ficus stupenda* Miq. *stilifera*
- Funicular segments of the antenna not longer than wide, with one row of sensilla. Female: ninth urotergite three times as long as the apparent gaster. Male: hind basitarsus longer than the three following segments combined . . . 2

2. Female: the head distinctly transverse (16 : 19); the eye not quite $1\frac{1}{2}$ times as long as the cheek (11 : 8). Male: the compound eye distinctly longer than the cheek (3 : 2). Ceylon, ex *Ficus religiosa* L. *infida*
 — Female: the head almost as long as wide (23 : 25); the eye twice as long as the cheek. Male: the compound eye as long as the cheek. Rhodesia, ex *Ficus burkei* *alata*

***Watshamiella alata* Wiebes, spec. nov.**

(figs. 61—63, 82, 85—92; pl. 2 figs. 5, 6)

Female. — Length of head, thorax and apparent gaster ca. 2 mm, the ninth urotergite ca. 3 mm i.e., three times as long as the apparent gaster. Colour yellow-brown, with black markings on the dorsum of the gaster.

Head (fig. 62) almost as long as wide across the compound eyes (23 : 25), the eye more than half as long as the head (14 : 23) and twice as long as the cheek. Antennal toruli widely spaced, situated rather low in the face, close to the epistomal margin; shallow scrobes run to about the middle of the face. Epistomal margin straight. Mandible tridentate, two glands; the labial palpus consisting of two segments (3 : 7), the maxillary of four (3 : 2 : 2 : 5). Antenna (fig. 63), formula 1135(3); the scape three times as long as the pedicel; the funicular segments with one row of sensilla, and with scattered setae.

Thorax. Pronotum long, about of the same length as the scutellum (which bears two long, posterior setae); the parapsidal furrows complete. Fore leg: the femur inflated, the tibial armature consisting of two dorso-apical spines and a bifid ventral spur, accompanied by some spines; the tarsal segments approximately in ratio 12 : 4 : 4 : 3 : 14. Mid leg: tarsal ratio 17 : 9 : 6 : 5 : 7. Hind leg: the tibia (fig. 89) with a rather straight apical edge, the armature consisting of stout spines next to the ventral spurs and six conical spines along the distal fifth of the dorsal margin; the tarsal ratio 8 : 5 : 3 : 2 : 3, i.e., the basitarsus as long as the combined lengths of the second and third segments. Fore wing (5 : 2) 1.6 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 15 : 10 : 3 : 9 (fig. 61), the surface hirsute; hind wing (4 : 1) 1.1 mm long.

Gaster shortly petiolate. Hypopygium (fig. 82) with an acute spine and three pairs of long setae. The ninth urotergite with small pygostyles.

Male. — Length of head, thorax and gaster ca. 1.7 mm. Colour yellow-brown.

Head (fig. 87) almost as long as wide across the compound eyes (13 : 14), the eye as long as the cheek. Three ocelli. Antennal toruli widely spaced, situated close to the epistomal margin, which is straight. Mandible bidentate, with two glands, but the inner tooth truncate and divided at the apex in some specimens; the labial palpus consisting of two segments (1 : 2), the maxillary of four (8 : 8 : 7 : 14). Antenna (fig. 85), formula 1135(3); the scape $2\frac{1}{2}$ times as long as the pedicel; the funicular segments with some large sensilla and mainly apical setae.

Thorax. Pronotum almost as long as the mesonotum; the parapsidal furrows almost complete. Fore leg (figs. 86, 91—92): the femur inflated, the tibial



Figs. 85—92. *Watshamiella alata* Wiebes, gen. & spec. nov., male (85—88, 90—92) and female (89). 85, right antenna, antiaxial aspect; 86, right fore leg; 87, head; 88, apex of hind tibia; and basitarsus; 89, apex of female hind tibia, axial aspect; 90, apex of gaster, with genitalia; 91, apex of fore tibia, and two tarsal segments; 92, do., detail in axial view.

armature much as in the female, the tarsal segments approximately in ratio 9 : 3 : 3 : 2 : 7. Mid leg: tarsal ratio 6 : 3 : 3 : 2 : 6. Hind leg (fig. 88) with seven conical spines along the distal third of the dorsal tibial margin and some ventral spines next to the spurs; the tarsal segments approximately in ratio 23 : 9 : 6 : 3 : 11. Fore wing (5 : 2) 1.3 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 26 : 23 : 9 : 18, the membrane hirsute; hind wing (5 : 1) 0.9 mm long.

Gaster shortly petiolate. Genitalia (fig. 90) with four claws on the claspers; pygostyles present.

Type material. — Holotype ♀ (slide-mounted), Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in RMNH, Leiden (no. 2966). Paratypes: series ♀ and four mating pairs, same data as holotype (coll. dates ii-v.1977); Chishawasha nr. Salisbury, 5 ♂, 1976 & vi.1977; Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, 5 ♀ 3 ♂, xii. 1976 (A. Watsham). The material is deposited in the RMNH, Leiden, some paratypes in the BMNH, London and in the Watsham Collection.

OTITESELLINAE

The Otitesellinae held my attention for some time (Wiebes, 1967: 435—441, 1969: 443—444, 1974: 145—161). They were formerly classified with the Torymidae, but now are transferred to the Pteromalidae. The females have a short ovipositor and for that reason were supposed to oviposit from within the receptacle; some have special features (rasps, stout spines) evidently related to the way of entering through the ostiole, but most have not. *Otitesella* Westwood, to which the species from *Ficus burkei* belongs, does not enter the receptacle for oviposition. The males are peculiar by their oversized head and mandibles. The main character by which the species of *Otitesella* and its close relatives can be distinguished, is found in the male thorax (fig. 94), the terga of which are all free; the female wings are almost hyaline. Immediate African relatives of the species here treated are *Otitesella africana* Grandi, *epicarioides* Grandi and *royi* Wiebes, with which the species from *Ficus burkei* is being compared in the following key.

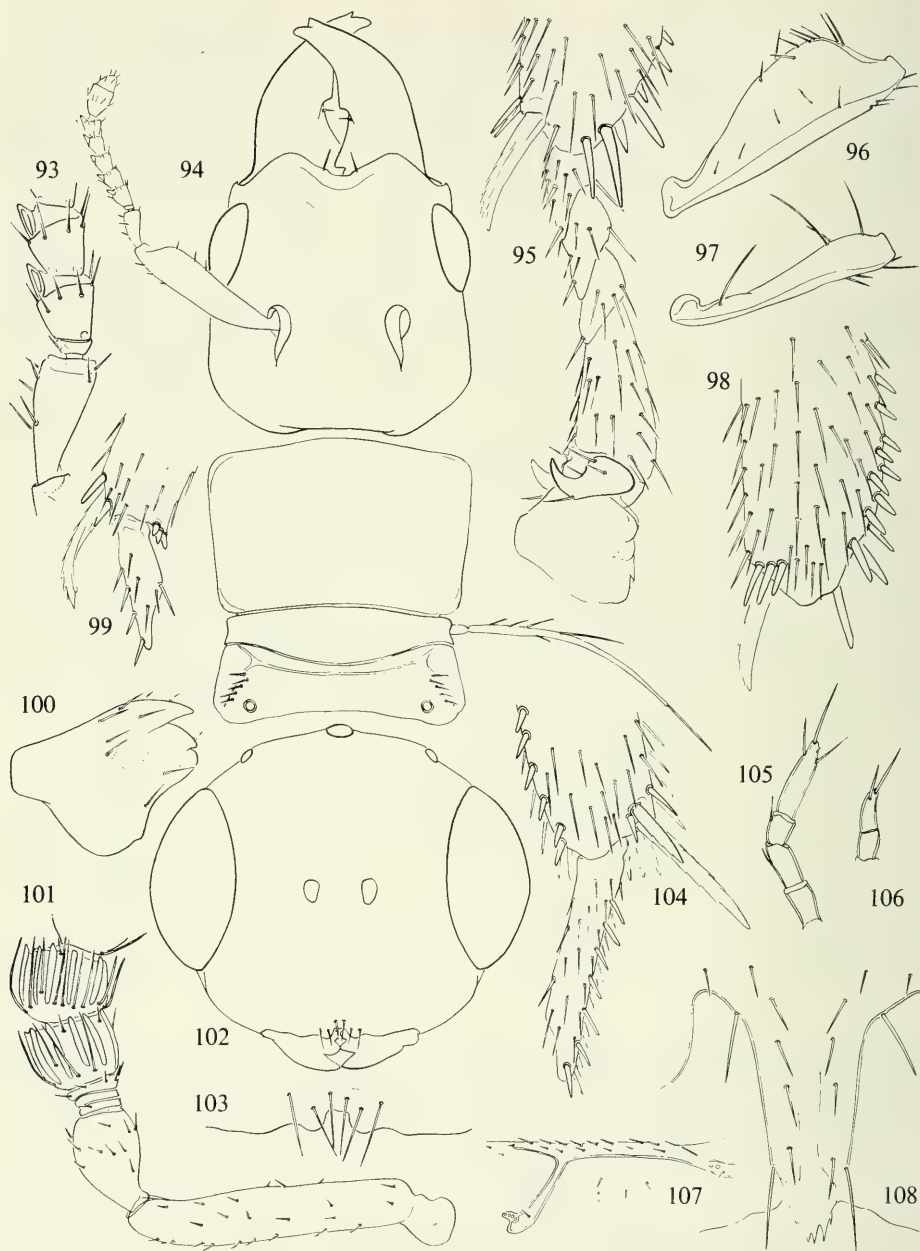
Key to some African species of *Otitesella*

1. Female: epistomal margin with a median lobe in between the lateral lobes. Male: head with a large anterior concavity reaching the antennal toruli. Eritrea, ex *Ficus* spec. *epicarioides*
- Female: epistomal margin with a median indentation in between the lateral lobes. Male: head convex dorsally, only faintly impressed in front 2
2. Female: the compound eye four times as long as the cheek. Male: toruli of the antennae distinctly situated between the eyes. Guinea, ex *Ficus vogelii* Miq. *africana*
- Female: the compound eye about twice as long as the cheek. Male: toruli of the antennae almost totally behind the posterior edge of the eyes 3
3. Female: the antennal anelli long, the distal one half as long as wide. Male: antenna with two distinct anelli. Guinea, ex *Ficus* cf. *eribotryoides* K. & B. ... *royi*
- Female: the antennal anelli (fig. 101) shorter, disk-like, up to five times as wide as long. Male: antenna with only one anellus. Rhodesia and Zambia, ex *Ficus burkei* and *petersii* *tsamvi*

Otitesella tsamvi Wiebes, spec. nov.

(figs. 93—108; pl. 1 figs. 5, 6)

Female. — Length 1.4—1.7 mm. Colour blackish, the tibiae and tarsi of the legs lighter.



Figs. 93—108. *Otitesella tsamvi* Wiebes, spec. nov., male holotype (93—98) and female (99—108). 93, apex of antennal scape, pedicel and three flagellar segments; 94, head and thorax; 95, apex of fore tibia, and tarsus, axial aspect; 96—97, antennal scapes of a large- and small-sized specimen, respectively; 98, apex of male fore tibia; 99, apex of female fore tibia, and basitarsus; 100, right mandible, ventral aspect; 101, basal segments of antenna, axial aspect; 102, outline of head; 103, epistomal margin; 104, apex of hind tibia, and basitarsus; 105, maxillary palpus; 106, labial palpus; 107, part of wing-venation; 108, hypopygium.

Head (fig. 102) shorter than wide across the compound eyes, twice as long as the cheek. The epistomal margin (fig. 103) broadly bilobate. Mandible (fig. 100) with three teeth; the labial palpus (fig. 106) consisting of two segments (11 : 16), the maxillary (fig. 105) of four (4 : 6 : 3 : 10). Antenna (fig. 101), formula 1135(3); the scape more than three times as long as the pedicel (13 : 4); the flagellum with five or six sensilla and long mainly basal setae visible in axial view of each segment, more and shorter setae over the whole of the disk and less sensilla in antiaxial view.

Thorax. The legs (hind leg, fig. 104) are quite similar to those of *O. epicarioides*. Fore wing (2 : 1) 1.3 mm long, the submarginal, marginal, stigmal and postmarginal veins approximately in ratio 30 : 9 : 8 : 4 (fig. 107, but in some specimens the stigmal and postmarginal are of almost equal length), hyaline, no fringe; the hind wing (4 : 1) 1.0 mm long, with a normal fringe.

Gaster. The hypopygium (fig. 108) has a short spine.

Male. — Length of the head (without mandibles) and thorax 0.9–1.0 mm. Colour yellowish.

Head (fig. 94) slightly longer than wide (greatest length: greatest width, 1.0 : 1.1), only faintly depressed above the epistomal edge and without a sulcus parallel to the posterior margin. The eyes large, more than thrice as long as the cheek (7 : 2) and more than half as long as the remaining posterior part of the head. The toruli of the antennae are situated in the posterior half of the head, well behind an imaginary line connecting the posterior margins of the eyes. Mandible two-thirds of the length of the head; three glands; the labial palpus consists of one segment, the maxillary of two (4 : 5). Antenna (figs. 93, 96–97), formula 1115(2); the scape distinctly expanded, only slightly so in smaller specimens; the pedicel about a quarter of the length of the scape; one anellus (it is difficult to distinguish between the stalk of the third segment and a possible extra anellus; even if the stalk is counted as a second anellus, there is a difference with *O. epicarioides* and *royi*, which then have three anelli: see Grandi, 1922, fig. vi 2); five subequal funicular segments, each with one antiaxial sensillum, and a divided club (2 : 1).

Thorax (fig. 94): the pronotum $1\frac{1}{2}$ times as wide as long, three times as long as the mesonotum is in the middle, and thrice as long as the propodeum is laterally. Wing remnant present. Legs (fore tibia, figs. 95, 98) much as in *O. epicarioides*.

Gaster. The claspers of the genitalia bear three claws.

Type material. — Holotype ♂ (slide-mounted), Zimbabwe-Rhodesia: Salisbury, ex *Ficus burkei*, ii.1977 (A. Watsham); deposited in RMNH, Leiden (no. 2971). Paratypes: series ♀ ♂ and 11 mating pairs, same data as holotype (coll. dates iii–iv.1977); Chishawasha nr. Salisbury, 3 ♀ 22 ♂, i, v.1975, ix.1976, i, vi.1977; Makumbi Mission, Chinamora Reserve, ex *Ficus burkei*, 35 ♀ 10 ♂, xii.1976 (A. Watsham). Zambia: Kafue National Park, Ngoma, ex *Ficus burkei*, 2 ♂, 8.xii.1977 (M. G. Bingham, no. 2465); Chipata Golf Course, ex *Ficus burkei*, 1 ♀, 11.i.1979 (M. G. Bingham, no. 2474); Chipata, ex *Ficus petersii*, 3 ♀ 7 ♂, 11.i.1979 (M. G. Bingham, no. 2475); Lusaka, Cathedral of the Holy Cross, ex *Ficus burkei*, 20 ♀ 20 ♂, 16.ii.1979 (M. G. Bingham, no. 2490). The

material is deposited in the RMNH, Leiden, some paratypes in the BMNH, London and in the Watsham Collection.

Derivation of the name. — Tsamvi is the vernacular name (Shonatribe) for *Ficus burkei*.

EPICHRYSOMALLINAE

Most of the described genera of this group were listed by Hill (1967), but so far no key to them has been published and most of them were not critically studied. Most of the descriptions were based on slide-mounted material in which it is difficult to see certain important characters and usually too much significance is ascribed to tiny differences in bristles on legs, wings and some other body parts. Unlike many other groups, in Epichrysomallinae the number of antennal segments and their shape is often different even in closely related species, often also in different sexes of the same species, and, if not corroborated by other features, seems to be of problematic value as a generic character. Unfortunately most of the existing generic descriptions were based on such characters, sometimes even on the still less reliable difference in the palpal segments. The validity of such genera was first questioned by Wiebes (1971: 382) when describing a new species from Sierra Leone. He decided then to place the species under the oldest name in the group, *Sycobia* Walker, 1871, and called it *S. africana*. Later (1975) he placed similarly another new species from the Aldabra Islands in the Indian Ocean, *Sycobia orientalis*. To my knowledge there is only one further species coming into our consideration, described by Risbec (1955a) from the Malagasy Republic (Madagascar) as *Callimomus imerinensis* (although some Indian species have been compared as well).

Epichrysomallinae seem to be confined to the tropics of the Old World and probably all are associated with figs. I have studied taxonomically at least two dozen species, some of which could be named, but am not yet quite sure about the range of some genera. The oldest genus, *Sycobia* Walker, is known to me only in the males of its type-species, *S. bethyloides* Walker from India. These males are quite distinct from the males of all African species (described or undescribed) and because it seems to me doubtful that the rather ordinary looking female assumed by some authors to belong to *S. bethyloides* really belongs there, I am reluctant to accept the name *Sycobia* for these species. The second oldest name is *Camarothorax* Mayr, 1906, based on *C. obscurus* Mayr from Java. Although I have not seen any material certainly belonging to this species (and the type material could not be located in the Mayr collection in Vienna), the description suggests a genus acceptable for most of the African species known to me. Therefore I transfer the three previously described African species to this genus and they should be known as *Camarothorax africanus* (Wiebes) comb. nov., *C. orientalis* (Wiebes) comb. nov. (both from *Sycobia*) and *Camarothorax imerinensis* (Risbec) comb. nov. (from *Callimomus*).

According to the emerging evidence Epichrysomallinae seem to oviposit into the female florets of figs. They gall them in a similar way as do the Agaonidae, but

they oviposit from outside. They are no pollinators and attack only figs of smaller size, with florets within reach of their coiled ovipositors (see Galil & Copland, 1981). If this picture of their biology proves accurate it remains to explain why their bodies are invariably so smooth (unsculptured).

Altogether four species have been found to occur in the figs of *F. burkei*, one belonging to a new genus *Sycotetra*, the remaining three to *Camarothorax* Mayr, as already mentioned also in the key above.

Sycotetra Bouček, gen. nov.

Type-species: *Sycotetra serricornis* Bouček, spec. nov.

Head in female with convex vertex, parascrobal areas and temples, and relatively deep scrobes; no interantennal ridge; occipital carina distinct only above level of foramen; in facial view head not as high as broad, with rounded converging genae; antennae inserted slightly above centre of face, distinctly above lower ocular line. Clypeus with bilobed lower margin, its median incision accompanied by round depression; dorsally not separated from supraclypeal area; its lateral margins strongly converging and just above tentorial pits less apart than one ocellus diameter, each margin then curving towards inner third of the closely approached antennal toruli. Mouth and mandibles of normal size. Antennal formula 1106(3), i.e., without distinct anellus; funicular segments very clearly separated by incisions, asymmetric, appearing distinctly serrate in the type-species (fig. 111); claval segments almost completely fused.

Thoracic dorsum virtually smooth, with few pairs of short bristles, only the pair at apex of scutellum long, upturned forwards. Pronotum medially shorter than mesoscutum; latter with strongly converging incomplete notaular lines (these not groove-like) which turn caudad at posterior end, at the medio-posterior pair of setae, still about a quarter of their length before transscutal suture. Scutellum rather broadly bordering on mesoscutum, this border about as broad as each axilla, but axillar lines anteriorly not marked as grooves on surface. Propodeum without significant sculpture; spiracle partly covered by transparent outer flange. Metapleuron hairy, its hairs much shorter than hairs on the flat propodeal callus. Mesopleuron with deep grooves separating subalar sclerite and lower epimeron, but groove indicating pleural suture (running from mid coxa to fore wing) completely effaced in ventral half. All tarsi four-segmented, basitarsus of mid and hind legs very long. Fore wing venation normal for the group, postmarginal vein however longer than half of the stigmal, which is curved and shorter than marginal vein.

Gaster sessile, slightly compressed from sides; epipygium with cerci situated dorso-laterally; hypopygium slightly exceeding three-quarters of gastral length.

In male head stouter than in female, especially temples more tumid; antennal formula 1105(3), antennal insertion below centre of face, lower margins of toruli slightly below lower ocular line; flagellum not serrate, its first segment usually smaller than any of subequal segments 2 to 5. Pronotum distinctly longer than in female and pubescence of fore wing more conspicuous. Gaster flat, subsessile.

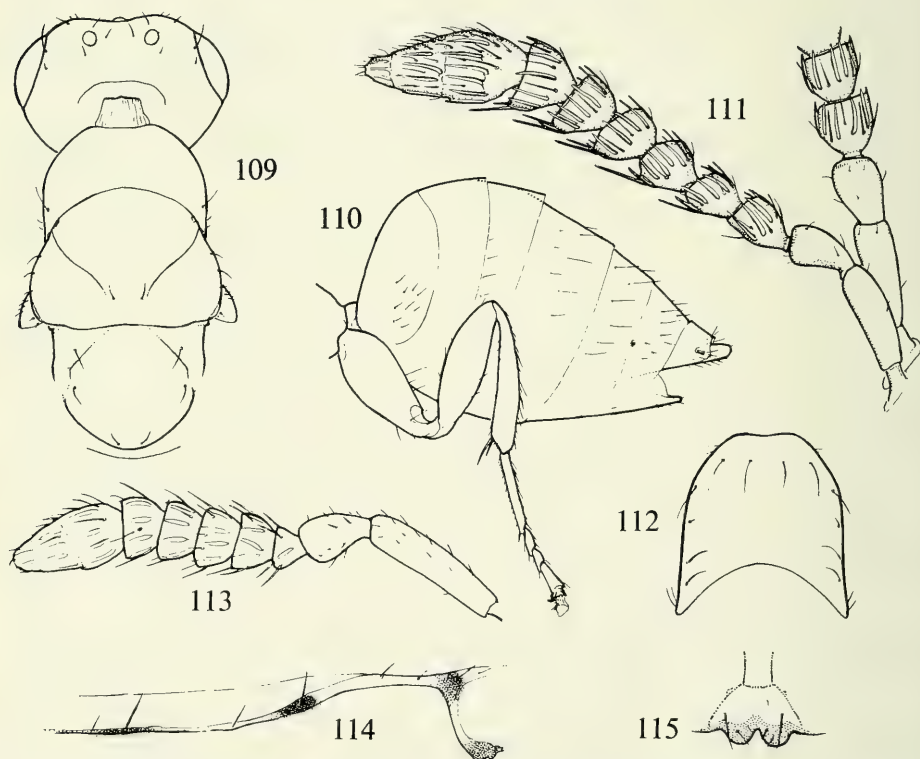
Comments. — *Sycotetra* differs from most of the known genera of Epichryso-

mallinae in having only tetramerous tarsi. These are also found in *Odontofroggattia* Ishii (1934), from which *Sycotetra* differs in having incomplete notauli, normal male mandibles (falcate in *Odontofroggattia*) and a subsessile male gaster (petiolate in *Odontofroggattia*, armed with lateral or ventral spines).

***Sycotetra serricornis* Bouček, spec. nov.**
(figs. 109—113; pl. 3 fig. 2)

Female. — Stretched body 2.0—2.7 mm. Testaceous, gaster usually darker brown; wings hyaline including most of marginal vein, venation otherwise brownish.

Head; relative measurements: breadth 85, length (dorsally) 47, height including clypeal lobes 72, breadth of frons 56, POL : OOL as 21 : 16, eye 40×32.5, malar space 19, mouth breadth 39, distance between toruli and median ocellus 26, scapus 20×7.5, flagellum plus pedicellus 93. Upper face with shallowly engraved striae merging at antennae with lengthened engraved reticulation. Malar sulcus obliterated, indicated merely by a narrow streak of denser reticulation. Antennal toruli about one-third of torulus apart. Flagellar segments (fig. 111) with



Figs. 109—113. *Sycotetra serricornis* Bouček, gen. & spec. nov., female (109—111) and male (112, 113). 109, head and thorax; 110, gaster and hind leg; 111, antennae, left one in lateral aspect, right antenna (part) in dorsal aspect; 112, male pronotum, dorsal aspect; 113, male antenna. Figs. 114, 115. *Camarothorax equicollis* Bouček, spec. nov., female. 114, venation of fore wing; 115, clypeus.

longitudinal plus trichoid sensilla, trichoid ones sparse on funicular segments, first segment ventrally flattened and there devoid of sensilla.

Pronotum about 0.8 of breadth of mesoscutum, its sides subparallel, anteriorly broadly rounded (fig. 109); its dorsum smooth. Flat; both hind and anterior margins of pronotum emarginate, length in median line only about 0.4 of maximum breadth and (in presumably normal position) about half as long as mesoscutum. Relative length of scutellum (less axillae) 60, breadth 50. Fore femur (less trochantellus) about 2.8 times as long as broad, about as broadened as hind femur; fore basitarsus dorsally as long as the second, mid basitarsus dorsally as long as rest of tarsus less claws, hind basitarsus relatively very slightly shorter. Fore wing venation see pl. 3 fig. 2.

Gaster hardly longer than thorax; in normal position tip of hypopygium reaching very nearly as far as apex of the spiracle-bearing tergite (fig. 110), most of hypopygium bare, except for few hairs at tip which is shortly produced (mucro).

Male. — Usually 1.5–1.8 mm (non-stretched specimens shorter, then length of body about equal to length of forewing). Antennae paler than in ♀. Head only 1.6 times as broad as long in dorsal view, with temples longer, almost parallel just behind eyes. For antenna see fig. 113. Pronotum (fig. 112) dorsally flat, its median length about 0.8 of the breadth, hind margin fairly deeply emarginate. Mesoscutum with distinct engraved striation generally parallel to notaular lines. Fore wing pubescence beginning at base of marginal vein (in ♀ bare area stretches to base of stigmal vein), similar to that shown in fig. 122.

Type material. — Holotype ♀ (on card), Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, ex *Ficus burkei*, xii.1976 (A. Watsham); deposited in BMNH, London. Paratypes: 44 ♀ 33 ♂ (1 ♂ observed mating with holotype ♀), same data as holotype; Chishawasha nr. Salisbury, 3 ♂, xii.1974, 5 ♀, ix.1974, iii. and v.1975 (A. Watsham). Some paratypes in RMNH, Leiden and the Watsham Collection.

Camarothorax Mayr

Type-species: *Camarothorax obscurus* Mayr.

For discussion on *Camarothorax* see above, under the heading Epichrysomalinae.

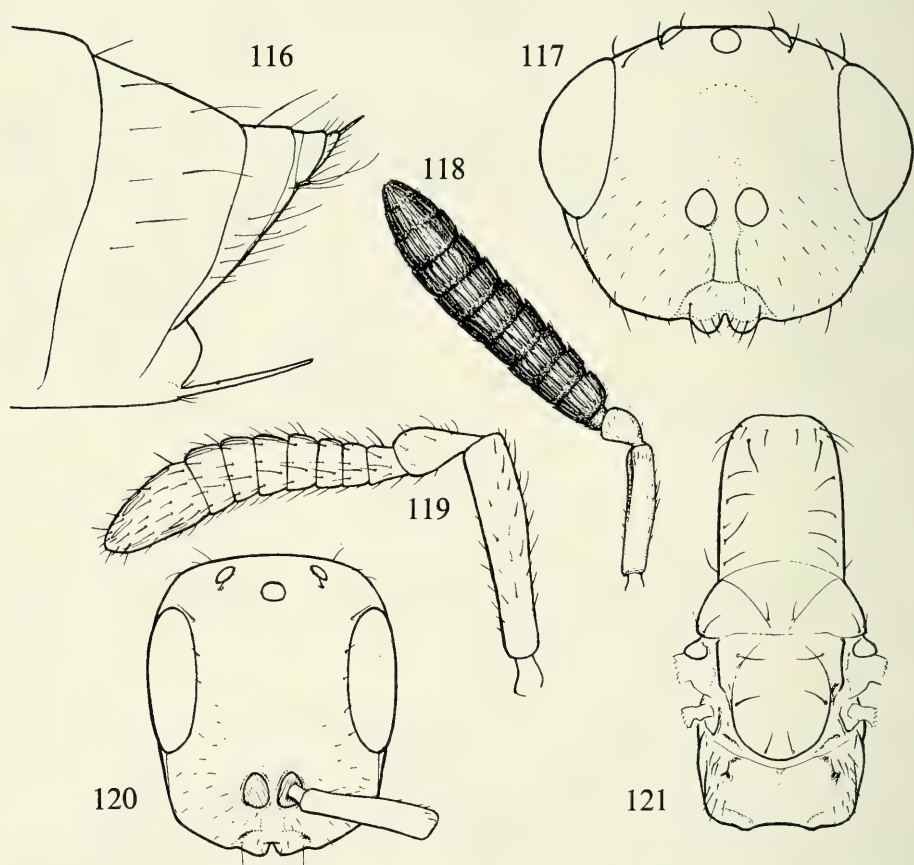
Camarothorax equicollis Bouček, spec. nov.

(figs. 114–121; pl. 3 fig. 3)

Female. — 2.2–2.7 mm. Reddish testaceous but often with gaster dark brown (except for paler base), as well as mesopleura, metathorax plus propodeum, antennal flagellum and legs except tarsi. Wings hyaline, including parts of venation which alternate with darker colour at base, middle and apex of submarginal vein and at base and apex of stigmal vein.

Head orthognathous, scarcely broader than mesoscutum (36 : 34), in dorsal

view fully 1.9 times as broad as long (stout), in facial view (fig. 117) barely 1.2 times as broad as high. Relative measurements: head width 89, frons 53, POL : OOL as 23 : 13, eye 40×34 , malar space 27, mouth 44; toruli 30 from lower margin of clypeal lobes, 20 from eye and 32 from median ocellus; slender scapus 31, flagellum plus pedicellus 86. Vertex very weakly convex, with bristles as in ♂ but without short ones mesad and laterad of ocelli; also sculpture and pilosity similar to that of male. Occipital carina conspicuous and complete, reaching mouth margin on hind side of head; temples rounded, short. Lower face with some very short hairs, longer hairs present only at mouth margin and on mandibles; clypeus subtriangular, its lower margin with two deeply separated lobes (fig. 115), dorsal margin against supraclypeal area indicated by dark line, supraclypeal area itself narrower than one torulus, almost parallel-sided, about three times as high as broad. Malar groove distinct. Antenna (fig. 118): pedicellus short; flagellum stout except for thin anellus, with seven funicular segments, all of them transverse, distal ones usually about twice as broad as long; formula 1117(3).



Figs. 116—121. *Camarothorax equicollis* Bouček, spec. nov., female (116—118) and male (119—121). 116, apex of gaster in lateral view; 117, head; 118, antenna; 119, male antenna; 120, male head; 121, male thorax, dorsal aspect.

Thorax shiny, with similar fine engraved striae as head; dorsally with two bristles on each side of pronotum, two posteriorly at each outer corner of mesoscutum, the meso-posterior pair more than twice from each other than from scutellum; on scutellum one pair of lateral bristles in middle of length and another pair at hind margin. Pronotum distinctly narrower than mesoscutum, its median length to breadth in ratio as 26 : 62; anterior corners broadly rounded. Notaular grooves shallow, posteriorly sinuate and meeting scutellum slightly inside of axillar grooves; latter grooves separated from each other by little less than breadth of one axilla (21 : 26). Relative length of scutellum 59, breadth 53, median length of propodeum 20. Propodeum with fine median carina accompanied by a groove connected anteriorly with a broader groove running along anterior margin, narrowing laterad and subdivided in several areolae; short carinae arising also from raised petiolar margin of propodeum; spiracle round, less than its diameter from metanotum, anteriorly overroofed by transparent flange; callus with long hairs, these reduced posteriorly to hardly more than one row. Metapleuron convex, reticulate, bare. Mesopleuron ventrally very flat, dorsally with longitudinal striation; a curved groove separating subalar sclerite, a distinct bent groove delimiting lower epimeron (katapimeron). Fore femur and hind femur each about three times as long as broad. Fore wing pilosity strongly reduced, hairs extremely short, sparse, marginal fringe absent; bristles of veins reduced to a few on darker parts of venation (fig. 114); relative measurements: costal cell length about 115, marginal vein 26, postmarginal 9, stigmal 18.

Gaster sessile, only moderately compressed from sides, hardly as long as thorax. Cerci close to each other, on ventral side. Hypopygium ending slightly beyond middle of gaster but with thin white median projection (mucro, fig. 116) about of length of hind basitarsus.

Male (pl. 3 fig. 3). — Stretched body 1.9–2.7 mm (holotype 2.6 mm). Dark brown, but mesothorax dorsally sometimes more or less testaceous; antennae, fore tibia and all tarsi testaceous. Wings slightly infumate but hyaline in basal one-third sending out a curved hyaline streak, also quadrangular area below marginal vein hyaline; venation brown, but marginal vein pale.

Head subprognathous, elongate-subquadrangular (fig. 120). Relative measurements: breadth 65, thickness 44, height (here = length) 78, breadth of frons 39, POL : OOL as 19 : 12, eye 38×26, malar space 23, width of mouth 44, distance between toruli and median ocellus 42, scapus length 37, pedicellus plus flagellum 69. Surface of body shiny, with very fine shallow engraved striation; short hairs scattered on lower face, spreading partly along inner orbits and across genae to temples; on vertex regular bristles: one in front of each lateral ocellus, one antero-laterad from that ocellus at eye margin, four bristles in cross-arch on vertex and a short bristle mesad of each lateral ocellus. Occipital carina even dorsally indistinct. Malar sulcus fine but distinct. No supraclypeal area, and clypeus ill-defined dorsally, very transverse, lobes of lower margin as if converging, separated by a subtriangular incision. Antennal insertion about half-way between ocular line and mouth margin, toruli close to each other. For antenna see fig. 119, formula 11071; scapus straight; first flagellar segment undivided,

distinctly longer than following one but scarcely as long as pedicellus; clava not distinctly subdivided.

Thorax with fine striation similar to that on head, dorsally slightly flattened, in shape slightly widening caudad (fig. 121), in stretched position about 2.5 times as long as broad. Pronotum about 1.2 times as long as broad, its hind margin only shallowly emarginate; sides subparallel. Mesoscutum (if pronotum in horizontal position) fully twice as broad as long, only half as long as pronotum; notauli extremely shallow though groove-like, very nearly complete, almost meeting on scutellar border. Scutellum about 1.2 times as long as broad, most of border with axilla indistinct. Propodeum subhorizontal, without significant sculpture, only medio-anteriorly with faint converging grooves separated by short fine carina. Metapleuron and mesopleuron as in female, only with odd hairs in front of mid coxae. Legs strong but tibiae and tarsi relatively long and slender; hind coxa pyriform, dorsally and laterally bare; fore femur stout, 2.1 times as long as broad, hind femur about 2.9 times as long as broad; mid basitarsus dorsally slightly shorter than combined dorsal length of segments 2 to 4. Proximal third of fore wing bare except basal cell and apex of costal cell, bare area stretching to base of stigmal vein; otherwise distinctly pubescent, hairs moderately dense; marginal fringe conspicuous; bristles on submarginal vein absent only on a short stretch just before parastigma.

Gaster flat, mostly short-oval.

Type material. — Holotype ♂ (on card), Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, ex *F. burkei*, xii.1976 (A. Watsham); deposited in BMNH, London. Paratypes: 12 ♀ 5 ♂, same data as holotype; Chishawasha nr. Salisbury, 11 ♀ 8 ♂, ix. and xii.1974, vii.1976, iii. and iv.1977 (A. Watsham). South Africa: Pondoland, Port St. Johns, 1 ♀, vii.1923 (R. E. Turner). Uganda: Kawanda, 1 ♀, ii.1939 (T. H. C. Taylor). Some paratypes in RMNH, Leiden and the Watsham Collection.

Comments. — This species, especially by its long "horse" head and pronotum (hence its name *equicollis*) reminds one much of *Camarothorax orientalis* (Wiebes) described in *Sycobia* from the Aldabra Islands (1975). *C. equicollis* differs from *C. orientalis* (of which I could examine the type material) in the female mainly by the lateral ocellus being nearer to the median ocellus than to the eye (the reverse in *orientalis*), a different disposition of hairs on the vertex, a slightly more transverse head (in frontal view), a much shorter pronotum (median length to breadth in *orientalis* as 13 : 26), and by the distinctly compressed gaster (not compressed in *orientalis*); in the male by the relatively less elongate head with larger eyes which are much longer than part of head anterior to eyes in *equicollis*, but only about as long in *orientalis*.

The above material of *C. equicollis* comes mainly from the Rhodesian *Ficus burkei*, but a very similar form is known to us from the figs of *F. petersii* from South West Africa (Namibia). The latter form cannot be separated morphologically but is much darker, having only the pronotum and lower parts of the head pale testaceous. I regard it as a form of *C. equicollis*, although the material is not included as paratypes (it may be a climatic form, or does the colour difference suggest a beginning of speciation?)

***Camarothorax longimucro* Bouček, spec. nov.**

(figs. 122—125; pl. 3 fig. 4)

Because of great similarity of this species to *C. equicollis* the stress is made in the following description on the diagnostic characters.

Female. — 2.05—2.35 mm. Testaceous, but propodeum and gaster sometimes slightly darker than the rest; wings hyaline, venation with a pattern similar to *equicollis* but generally paler.

Head in dorsal view transverse-quadrangular, about 1.85 times as broad as long, with swollen temples which are subparallel for short distance at eyes; in facial view (fig. 125) head nearly 1.2 times as broad as high. Sculpture on head, as well as on thorax, similar to that of *equicollis*, but deeper, therefore surface duller. Relative measurements: head breadth 83, frons 51, POL : OOL as 22 : 14, eye 34×29, malar space 24, mouth 42, toruli 25 from lower margin of clypeal lobes and 33 from median ocellus (lower torular margin on lower ocular line), scapus 31, flagellum plus pedicellus 82. Ocellar angle about 135°, ocellar area about three times as broad as high. Compared with *equicollis* eyes are smaller, supraclypeal area (separated by distinct line from clypeus, fig. 125) is only about twice as high as broad, as broad as one torulus; antennae inserted slightly lower on face, pedicellus fully 1.6 times as long as broad, flagellum slightly more slender, with only six funicular segments.

Pronotum parallel-sided, only 0.75 times as broad as mesoscutum, its median length about 0.47 the breadth; anterior corners (shoulders) subrectangular. Notaular grooves meeting scutellum slightly outside of axillar grooves; latter grooves separated anteriorly by distance subequal to half breadth of axilla. Scutellum about 1.15 times as long as broad, posteriorly more regularly semicircular than in *equicollis*, but propodeum and sculpture of pleura as in that species, except that metapleuron is narrower, hind lateral corner of propodeum slightly more produced, the groove delimiting subalar sclerite ventrally is straight. Legs relatively slender; fore femur about 2.5 times, hind femur nearly 3 times as long as broad; hind basitarsus dorsally about as long as rest of tarsus (less pulvillus). Fore wing as in *equicollis*, relative length of costal cell 120, marginal vein 26, postmarginal 10, stigmal vein 21.

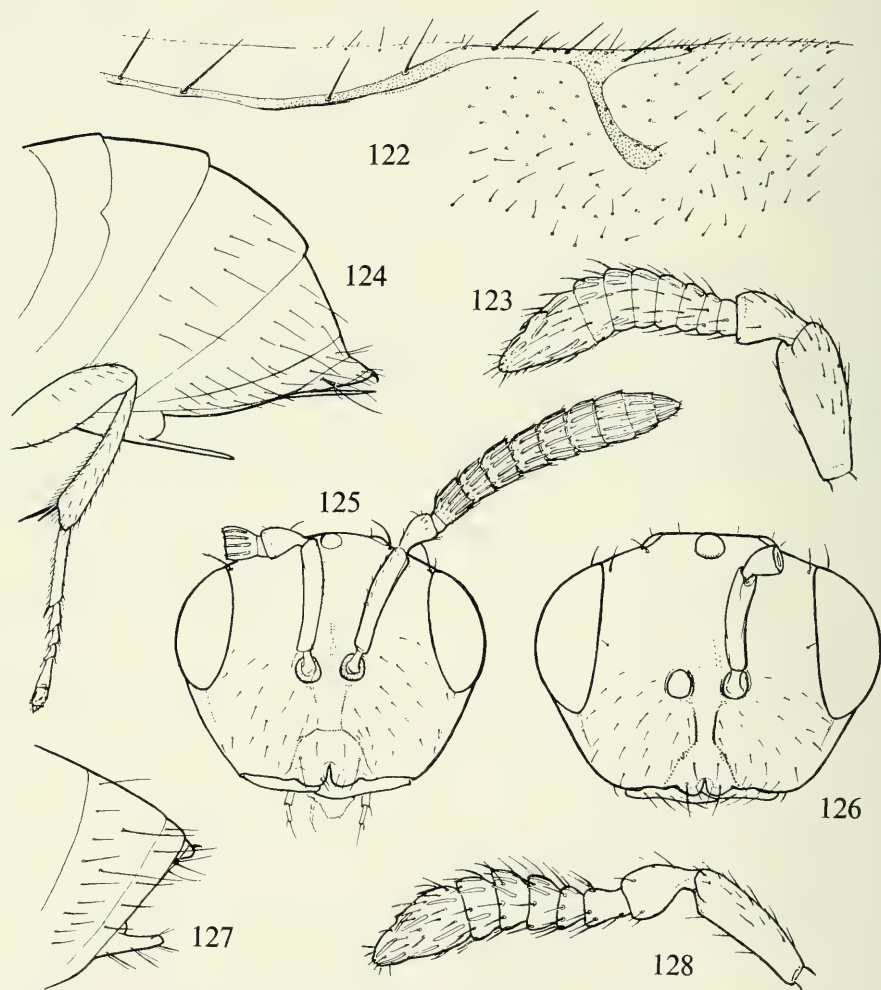
Gaster sessile, fairly compressed from sides, about as long as head plus thorax combined. Hypopygial mucro slender (fig. 124), about as long as two basal segments of hind tarsus combined. Cerci situated ventrally, close to each other.

Male. — About 1.7—1.9 mm (if stretched). Pale testaceous (only eyes, ocelli and pulvilli dark); fore wing venation (fig. 122) pale, only parastigma and stigmal vein more pigmented.

Head almost orthognathous (mouth downwards), in facial view fully 1.1 times as broad as high. Relative measurements: breadth of head 71, length (dorsally) about 40, height 62, frons 42, eye 34×26, malar space 16, scapus 25×9, flagellum plus pedicellus 55. Occipital carina fine and developed only dorsally. Head narrower in temples than across eyes but temples parallel for short distance just behind eyes; a few additional hairs posteriorly on vertex; two pairs of dorsal adorbital bristles (one pair in *equicollis*). Antennal toruli situated below lower

ocular line; supraclypeal area short, with sides diverging upwards, ventrally separated by distinct line from clypeus. Antenna short and stout, clavate (fig. 123); scapus slightly narrowed basally; flagellum more distinctly tapering towards base; seven distinct funicular segments, no anellus.

Thorax long, with large pronotum which is about 0.85 times as broad as mesoscutum, but normally (in subhorizontal position) distinctly longer; maximum length of pronotum equal to breadth, but because of emargination of hind margin, in median line shorter than broad as 45 : 54, broadly rounded anteriorly; pronotum dorsally nearly smooth, with 4 to 6 bristles in an anterior cross-line, one pair of sublateral bristles behind this row and 4 bristles at hind margin (submedian ones more apart). On propodeum the T-shaped groove obliterated;



Figs. 122—125. *Camarothorax longimucro* Bouček, spec. nov., male (122, 123) and female (124, 125). 122, venation of fore wing; 123, antenna; 124, female gaster and hind leg; 125, female head and antenna. Figs. 126—128. *Camarothorax brevimucro* Bouček, spec. nov., female (126, 127) and male (128). 126, head; 127, apex of gaster; 128, male antenna.

also grooves on mesopleuron almost obliterated. Legs strong and stout; fore femur hardly 2.1 times, hind femur about 2.4 times, as long as broad; fore tarsal segments 1 to 4 very short; hind tibia dorsally bristly; hind basitarsus dorsally about as long as segments 2 plus 3 combined (dorsally). Fore wing (fig. 122) with pilosity similar to that of ♂ *equicollis*; on lower surface pubescence extending partly to marginal vein.

Gaster flat, much shorter than thorax.

Type material. — Holotype ♀ (on card), Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, ex *F. burkei*, vi.1977 (A. Watsham); deposited in BMNH, London. Paratypes: same origin as holotype, 2 ♂, 3.xii.1974 and 5 ♀, 1976. Some paratypes deposited in RMNH, Leiden, PPRI (Plant Protection Research Institute), Pretoria and the Watsham Collection.

Comments. — The name of *C. longimucro* refers to the unusually long spine-like projection (mucro) of the female hypopygium. In this respect the species is similar to *C. equicollis*. The female looks otherwise very much as that of *C. brevimucro*, especially in the antennae, but the males of the two species have very different antennae and the female of *C. brevimucro*, as the name suggests, has only a short projection on its hypopygium. *Camarothorax longimucro* is also similar to *C. africanus* (Wiebes) from West Africa. The latter species differs from *C. longimucro* by its larger size, and in both sexes by a more robust body with a stout head which looks subquadrangular dorsally and is, in female, only about 1.65 times as broad as long, with the occipital carina nearly reaching the level with ocelli (this carina much lower in *longimucro*), the pronotum with almost parallel sides and longer, in female medially about 0.6 times as long as broad, in both sexes of *C. africanus* the axillar grooves are rather strongly converging forwards, thus considerably narrowing the anterior margin of the scutellum, and the clypeus is distinctly separated from the supraclypeal area (as in *C. longimucro*, fig. 125, but unlike in the otherwise also similar *C. brevimucro*, fig. 126).

***Camarothorax brevimucro* Bouček, spec. nov.**

(figs. 126—128; pl. 3 fig. 5)

Female. — 1.3—2.5 mm (holotype 1.8 mm). Testaceous to dark brown, sometimes either pale or dark, usually pale colour spreading first on sides of pronotum, then on lower parts of head and in a streak on sides of thoracic dorsum including fore coxa, prepectus and sides of scutellum (so in holotype). Wings hyaline, venation uniformly pale brown. Otherwise very similar to *C. longimucro*, hence stress is made on diagnostic characters.

Head with occipital carina reaching higher up than in *longimucro*, therefore vertex less sloping posteriorly. Ocellar area about twice as broad as long, angle of ocelli about 120°. In facial view (fig. 128) head rather transverse, about 1.37 times as broad as high; clypeal lobes rather short, clypeus dorsally confluent with supraclypeal area. Relative measurements: breadth of head 78, frons 48, POL : OOL as 18 : 11, eye 34×29 (rather large), malar space 20 (relatively

short), scapus 22, flagellum plus pedicellus about 60. Flagellar segments mostly more transverse than in *longimucro*.

Thorax slightly stouter than in *longimucro*; median carina on propodeum reduced to mere rudiment anteriorly; several bristles on dorsal part of metapleuron. Fore and hind femur each about 2.5—2.6 times as long as broad. Relative measurements in fore wing: costal cell length 95, marginal vein 18, postmarginal about 6, stigmal vein 18 (the marginal relatively short).

Gaster sessile, only moderately compressed from sides, about as long as thorax. Hypopygium reaching near to apex of gaster, its median projection (mucro) short (fig. 127; hence the name).

Male. — 1.4—1.9 mm. Mainly yellowish but often with darkened gaster and, usually less distinctly darker on vertex and on median parts of thoracic dorsum. Wings mostly hyaline but sometimes slightly infumate, mainly with a faint median streak and more infumate in basal half where a strongly curved line following the cubital vein and another longitudinal streak along hind margin are left hyaline.

Very similar to ♂ of *longimucro* but body less slender and antennae only with five segments between pedicellus and clava (fig. 128); clypeus dorsally fused with supraclypeal area; vertex subhorizontal behind ocelli, relative distance between lateral ocelli (POL) 18, both only 14 from distinct occipital carina; length of pronotum medially about 0.65 the breadth, in two-thirds of length with a pair of submedian bristles. Fore femur nearly 2.3 times as long as broad (hind femur barely more slender); fore tarsus very short; hind basitarsus about as long as three following segments combined, measured dorsally. Fore wing pilosity about as in *C. equicollis*: relative length of marginal vein 22, postmarginal about 3 (indistinct), stigmal vein 19. Gaster subpetiolate, flat, short oval; median length of petiole barely a third of maximum breadth.

Type material. — Holotype ♀ (on card), Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, ex *F. burkei*, xii.1976 (A. Watsham); deposited in BMNH, London. Paratypes: same data as holotype, 100 ♀ 109 ♂; Chishawasha nr. Salisbury, 24 ♀ and 8 ♂, ix.1974 and 1976, ii.iii. and vi.1977; Chinamora Reserve, 1 ♀, iii.1975 (all A. Watsham). South Africa: Pondoland, Port St. Johns, 1 ♀, viii.1923 (R. E. Turner). Some paratypes deposited in RMNH, Leiden, PPRI, Pretoria and the Watsham collection.

Comments. — The main characters separating this species are summarized in the key and in the comments on *C. longimucro*. The male of *C. brevimucro* is similar in many features to that of *Sycotetra serricornis*, but it has complete notaular grooves, five-segmented tarsi and differs otherwise in various details mentioned in the description.

EURYTOMINAE

Figs, even if inhabited only by the pollinating Agaonidae, represent an ecological niche virtually identical to many plant galls and as such attract many

species of gall-inhabiting Eurytomidae. All the African species associated with figs belong to subfamily Eurytominae, as defined by me earlier (e.g., in Peck, Bouček & Hoffer, 1964 : 23) and quite recently by Subba Rao (1978). There seems to be no good reason to split the subfamily, as some authors traditionally did. Eurytominae include a variety of genera, with numerous species both of phytophagous and entomophagous habits.

There are still considerable difficulties with the range of many genera and it proved the best way to place two of the species associated with *Ficus burkei* into two new genera, whilst the majority belongs to *Sycophila* Walker and one species can be undoubtedly classified as *Eurytoma* Illiger. Their separation is summarised in the key, based mainly on practical characters (not necessarily of generic value, as some, e.g., in *Eurytoma ficusgallae*).

Eurytoma Illiger

One species, apparently undescribed, belongs to this well known genus.

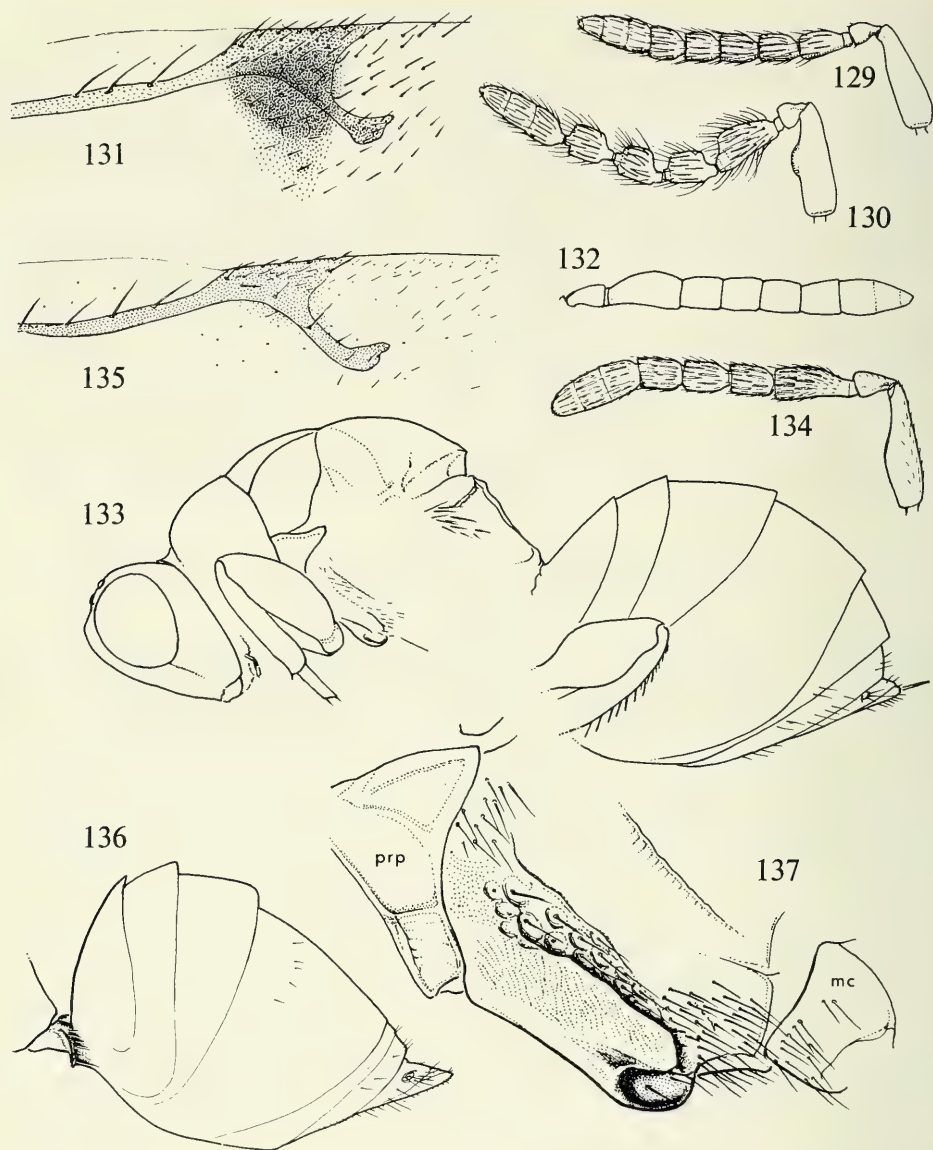
Eurytoma ficusgallae Bouček, spec. nov.

(figs. 129—130; pl. 3 fig. 6)

Female. — 2.5—3.4 mm (holotype 3.3 mm). Black; head and thorax with short silvery pubescence; antennae, tegulae, venation and legs beyond coxae rufous, tarsi paler, sometimes pedicels infuscate, rarely also femora; wings hyaline.

Head dorsally twice as broad as long, anteriorly 1.4 times as broad as high; densely umbilicately punctured, including malar space, but on lower face punctures confluent into grooves separated by raised striae radiating from depressed clypeal margin. Frons convex but not bulging; deep scrobes barely narrower than parascrobal area, its edges carinate, especially in upper third, united at ocellus, in a slight depression. Inner orbits with slight carina. Hairs on face very dense and flattened, arranged as if radiating from antennal base; lower edge of toruli at half distance between median ocellus and the emarginate mouth margin; on lower face median stria raised slightly more than others. In frontal view, mouth margin medially distinctly emarginate and depressed (including clypeus) but raised laterad of clypeus, narrowly notched above base of each mandible so that genal lamina projects there as a tooth; malar sulcus absent. Relative measurements: head width 55, frons 34, POL 12.5, OOL 7, eye 22×20, malar space 18.5, scapus 17×5, flagellum plus pedicellus 52. Antenna 11153; scapus reaching top of median ocellus, distinctly tapering in apical third (fig. 129); pedicellus subglobose; funicular segments oblong, the first distinctly, the fifth only slightly longer than broad, all with sparse longitudinal sensilla.

Thorax: densely punctate; dorsum about 1.43 times as long as mesoscutum broad; pronotal sides rounded, anteriorly slightly carinate (carina vertical). Hind margin of mid lobe of mesoscutum in middle slightly produced. Tegula distinctly striate-reticulate at hind margin. Scutellum rather flat, at apex broadly rounded (almost truncate) and with hairs directed towards median line; axillula impunctate, well delimited even dorsally, its posterior subvertical border out-



Figs. 129, 130. *Eurytoma ficusgallae* Bouček, spec. nov. 129, female antenna; 130, male antenna. Figs. 131—134. *Ficomila gambiensis* (Risbec), female (131—133) and male (134). 131, venation of fore wing; 132, antenna (less scapus); 133, body in lateral view; 134, male antenna. Figs. 135—137. *Ficomila curtivena* Bouček, gen. & spec. nov., female. 135, venation of fore wing; 136, gaster; 137, lateral aspect of part of thorax, showing prepectus (prp), mesopleuron with characteristic feature of the genus, and mid coxa (mc).

standing. Propodeum steep; the irregularly round large median area only slightly depressed, with low weak cross-carinae arranged as a tree: lower ones nearly horizontal, upper ones increasingly turning upwards; bottom between them reticulate; margins of area partly carinate against the foveolate-areolate

convex sublateral parts. Mesopleuron in posterior part horizontally rugulose-striate, anteriorly with epicnemial area delimited by subparallel low keels and containing a partly doubled row of piliferous puncta. Mesosternal shelf distinctly delimited by wavy carina, its minimum length (in front of each mid coxa) equal to breadth of fore tibia; ventral surface hairy, with a few hairs also in front of the shelf carina. Fore coxa anteriorly hairy, with strong oblique lamina beyond basal third; mid coxa without auricular lamella. Hind tibia on dorsal edge with a row of about 9 slightly alternating bristles, longest one as long as inner spur. Fore wing with marginal, postmarginal and stigmal veins subequal in length; basal cell hairy in distal third; costal cell pubescent on ventral surface but dorsally bare.

Gaster sessile, about as high and long as thorax but narrower, compressed, though not keeled dorsally; in median line tergites 2, 3 and 4 subequal in length. Surface smooth, but beginning with fourth tergite finely punctulate; fourth tergite sublaterally at base with a row of hairs which is more complete on the fifth, sixth tergite wholly hairy; epipygium very short, barely up-turned.

Male. — 1.7–3.0 mm. Pubescence on head and thorax, especially on face, golden. Flagellum brownish, with 4 bristly funicular and 3 claval segments (fig. 130). Scapus with distinct granulate boss beyond middle; first funicular segment distinctly elongate, segments 2 to 4 subequal, very slightly longer than broad. Antennal insertion distinctly above middle of face. Median area of propodeum more coarsely sculptured than in ♀. Gastral petiole about 1.5 times as long as broad, laterally and anteriorly carinate, dorsally rather flat, granulate, anterior crestlike margin arcuate.

Type material. — Holotype ♀: Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, xii.1974 (A. Watsham); deposited in BMNH, London. Paratypes: 13 ♀ and 9 ♂, same origin as holotype, mostly reared from galled figs of *F. burkei*, ii.1974, iii.-xi.1975, ii.1976; 15 ♀ and 4 ♂, Makumbi Mission nr. Salisbury, same host, xii.1976 (all A. Watsham). Some paratypes deposited in RMNH, Leiden and in the Watsham collection.

Comments. — *Eurytoma ficusgallae* seems to be easily separable from all the described African species of the genus. By the combination of the well delimited (carinate) mesosternal shelf and the presence of an oblique laminate carina on fore coxa, *E. ficusgallae* approaches the *nodularis*-group of *Eurytoma*. However, unlike the latter group, it has the coarse radiating striation on the lower face, with a medially emarginate and depressed mouth margin. This character, combined with the mesosternal shelf, is present in the *braconidis*-group (parasites in cocoons of Braconidae and Ichneumonidae, etc.), but there the shelf is differently formed (not well delimited laterally), the massive genal carina merges smoothly with the sublateral mouth border and there is a pair of outstanding carinae below the antennae, instead of a median carina as in *ficusgallae*. The facial radiation reminds one also of the *robusta*-group but in those species the fore coxa has on its anterior face just a shallow longitudinal channel, not a laminate carina. This carina is further present in the *latroducti*-group (called *Desantisca* by Burks; parasites in spider egg-cocoons) the species

of which much resemble *E. ficusgallae* also in many other characters and are also similar and closely related to the *braconidis*-group. The *latrodecti*-group differs in having a relatively deep reticulation on the tegulae and in female sex loose funicular segments.

Syceurytoma Bouček, gen. nov.

Type-species: *Syceurytoma ficus* Bouček, spec. nov.

Body generally in shape and sculpture as in most *Eurytoma* species, i.e., with head and thorax densely umbilicately punctured, with very short pubescence. Head transverse; scrobes reaching ocellus, not broader than parascrobal area. Interantennal crest small but high, doubled by broad median groove. Lower face coarsely striate, median stria slightly raised; striae radiating from lower clypeal margin which is slightly bilobed: lobes separated by depression in emargination; tentorial pits indistinct. Malar sulcus slightly indicated, about as long as shorter diameter of the relatively small eye. Gena posteriorly with strong laminate carina joining ventrally the reflexed-carinate mouth border. Occipital carina low, ending near middle of posterior genal carina by a small tooth and this connected by horizontal carina with hypostomal carina (which delimits the cavity containing mouth organs). Antennae inserted slightly above middle of face, formula in female 11153, with scape narrowed apically and with small anellus; in male 11143, with funicular segments more distinctly constricted at both ends, longer and more hairy: hairs semidistant and about as long as breadth of segments and mostly not distinctly whorled (fig. 140).

Pronotum large and virtually as broad as, and slightly longer than, the mesoscutum; antero-laterally with vertical carina. Scutellum as in *Eurytoma*; axillulae not well delimited. Propodeum steep, medially depressed, irregularly alveolate, anteriorly with two carinae diverging from middle as in *Sycophila*. Mesopleuron anteriorly delimited by epicnemial strip which is reduced in ventral half to single carina; this carina becomes high laminate where turning mesad, there marking off short mesosternal shelf; more mesad carina lowered and joining in median line a double rounded projection (fig. 138); this projection is strongly excavated from either side and anteriorly connected with two weaker subparallel carinae, each with a side branch. Fore coxa laterally carinate but its anterior face rather flat, with slight meso-distal depression. Fore wing much as in *Sycophila*: marginal vein strongly enlarged (more so in male than in female), accompanied by a slight infuscation; postmarginal and stigmal veins short (fig. 139).

Gastral petiole subquadrate in female, in male distinctly elongate, dorsally flat, anteriorly expanded on sides (fig. 141), with sharp anterior crest. Gaster globose, in female broad and dorsally only weakly convex, with third tergite the longest.

Comments. — The new genus is proposed, rather reluctantly, for a distinctive species which shows affinities both to *Eurytoma* Illiger and *Sycophila* Walker. It is described after an attempt at a critical analysis of the characters used previously as generic characters, but also including a number of new ones. The only

alternative to this generic separation would be a union of many genera of the former Eurytominae, Eudecatominae and Harmolitinae, which, indeed, I regard all as belonging to Eurytominae (in Peck, Bouček & Hoffer, 1964: 23). These subfamilies are still maintained by some authors, in my opinion without good reason.

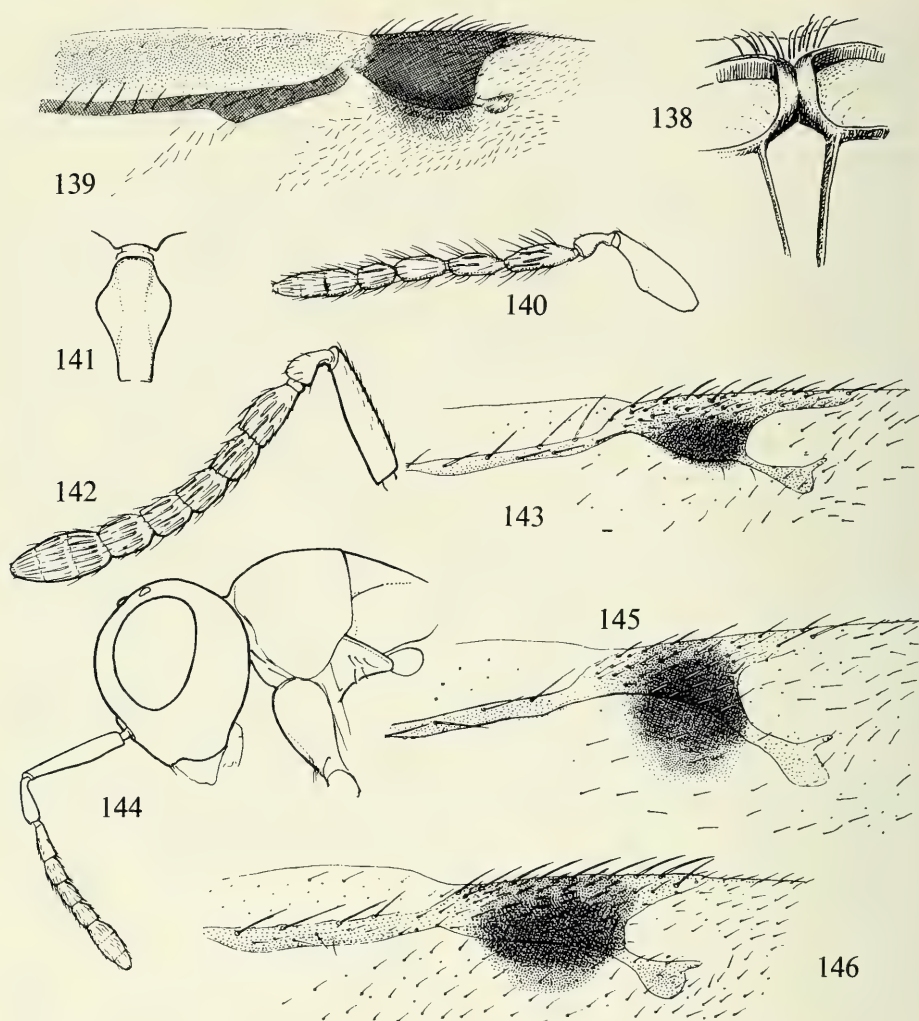
Another genus which to some extent intergrades between *Eurytoma* and *Sycophila* is *Paradecatomia* Masi. It was originally based on a single female named *Paradecatomia bannensis* Masi from Somalia but is known to me now in both sexes from Ethiopia (Harrar), Yemen, Tanzania and South Africa (Port St. Johns). Some specimens were apparently reared but no host data are attached. *Paradecatomia* has the posterior genal carina (I think that "postgenal carina" of Claridge is rather occipital carina) strong and complete as in *Syceurytoma* and most *Eurytoma*, but has, apart from other characters, an impunctate boss on malar space, the lower margin of clypeus with a small median tooth, a cross-striate and hairy anterior face of fore coxa, a coarsely punctured and hairy long mesosternal shelf which is anteriorly not carinate but abruptly turning smooth, and the male antennal flagellum with six two-whorled funicular segments plus an indistinctly 3-segmented clava. The bristly male flagellum puts *Paradecatomia* nearer to *Eurytoma*, but again the marginal vein is enlarged and stigmated by infuscation, although short and with certain similarity to the genus described here below, *Ficomila*. In the Eurytominae the posteriorly rounded gena seems to indicate, at least to some extent, a degree towards phytophagy, as suggested by the rounded gena in *Tetramesa* Walker, *Systole* Walker, *Bruchophagus* Ashmead (and the extremely close *Risbecoma* Subba Rao, 1978, based on the supposedly parasitic *Eurytoma bruchocida* Risbec which is in fact phytophagous in the *Acacia* seeds!). If this hypothesis works, both *Syceurytoma* and *Paradecatomia* should be parasitic in habit.

***Syceurytoma ficus* Bouček, spec. nov.**

(figs. 139—141; pl. 4 figs. 1, 2)

Female. — 2.1—3.4 mm. Ochreous to rufous, sometimes (especially in small specimens) with black spreading from median line on thorax and vertex.

Head; relative measurements: breadth 68, length 36, height 52, frontovertex 45, POL 13, OOL 13, eye 24.5×20, malar space 22, scape 21.5, flagellum plus pedicellus 59. Fine granulate reticulation on scapus confluent near base into cross-striation. Narrow interstices of umbilicate punctures on head and thorax reticulate. Punctured thoracic dorsum only about 1.44 times as long as broad. Anterior margin of pronotal collar broadly emarginate in middle, its sides longer than half its breadth (33 : 62). Scutellum barely longer than broad. Propodeum rather steep, convex, except for shallow median depression; mainly irregularly alveolate behind two carinae diverging from middle anteriorly and arcuately turning to anterior end of spiracles; sometimes median depression partly delimited by subparallel irregular carinae (more often in smaller specimens). Exposed part of prepectus concave, about as large as tegula, separated by a carina from the normally concealed part which is broad channel-like. Fore wing: costal cell dorsally nearly bare but densely pubescent underneath; basal third of



Figs. 138—141. *Syceurytoma ficus* Bouček, gen. & spec. nov., female (138) and male (139—141). 138, characteristic sculpture on mesosternal part; 139, venation of male fore wing; 140, male antenna; 141, gastral petiole of male. Figs. 142, 143. *Sycophila kestraneura* (Masi), female. 142, antenna; 143, venation of fore wing. Figs. 144, 145. *Sycophila punctum* Bouček, spec. nov., 144, male head with antenna and part of thorax; 145, venation of female fore wing. Fig. 146. *Sycophila sessilis* Bouček, spec. nov., venation of female fore wing.

wing below submarginal vein mainly bare, but basal fold with hairs in 1 or 2 rows; parastigma distinctly enlarged; marginal vein broader than length of stigmal vein, its lower margin slightly convex.

Gastral body broadly convex; exposed part of third tergite nearly to about twice as long as the second, both smooth; epipygium very short, transverse, barely up-turned.

Male. — 1.45—3.4 mm. Thorax usually with black widespread, more than in

darkest female, sometimes whole dorsal side of body black, rarely wholly ochreous as in most females. Antenna in most specimens not appearing very bristly (fig. 140) but bristles often more outstanding in smaller specimens and then fourth funicular segment with two whorls. For gastral petiole see fig. 141, for fore wing venation fig. 139, made from a specimen of size over 3 mm; smaller specimens have hairs relatively sparser, in large specimens also wing blade is partly infusate.

Type material. — Holotype ♀: Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, from *F. burkei* (= "*natalensis*"), 10.xii.1974 (A. Watsham); in BMNH, London. Paratypes: 104 ♀ and 61 ♂, same origin as holotype, xi.1974—vi.1975, ii.1976; 38 ♀ and 5 ♂, Makumbi Mission nr. Salisbury, iv.1975 and xii.1976 (all A. Watsham). Uganda: Kampala, "ex stem galls on *Ficus sycomorus*", 3 ♀, 3 ♂, 8.x.1935 (H. C. Taylor). South Africa: 1 ♂, Zululand, Eshowe, iv.1926 (R. E. Turner); 1 ♀, 1 ♂, Natal, Weenen, xi.1923 (H. P. Thomasset); 3 ♀, Pondoland, viii. and xi.1923 (R. E. Turner); 1 ♀, East London, v.1923 (N. K. Munroe). Paratypes are deposited in RMNH, Leiden and in the Watsham collection.

Ficomila Bouček, gen. nov.

Type-species: *Ficomila curtivena* Bouček, spec. nov.

Punctuation on head obliterate but on thorax often distinctly umbilicate, becoming relatively less dense and obliterate in smaller and pale-coloured specimens, usually absent on median part of scutellum in males. Scrobes deep but not carinate on margins, not reaching ocellus; interantennal ridge ending in abrupt angular tooth; antennal toruli slightly above middle of face. Clypeus delimited laterally by grooves reaching tentorial pits; lower margin bilobed. Malar groove distinct; gena posteriorly edged as in *Sycophila*; occiput with weak and low occipital fold (normally developed as carina running from upper margin of foramen obliquely towards mouth corners) only half way down, ending at change of plane. Female antenna 11153; scapus tapering apically; funicular segments short; male antenna 11143; first funicular segment the longest, constricted at base, longer than pedicel.

Pronotal collar on shoulders only bluntly edged, not carinate. Scutellum with axillulae indistinctly separated. Propodeum: median part flat or weakly concave, moderately finely reticulate in larger specimens, in smaller ones sculpture partly obliterate; median area anteriorly delimited by arcuate carina which broadly touches metanotal margin (as in some *Sycophila*, slightly less broadly than in *Systole* and *Bruchophagus*). Mesepimeron horizontally striate, separated from mesepisternum by fine carina; mesosternal shelf partly delimited: sublaterally by short cross-carina as continuation of epicnemial edge (weak in some males) and in middle by a rounded or slightly depressed (but still very distinct) projection which is hollowed from both sides into a shape of a little elongate window (fig. 137), similar to that of *Syceurytoma* (fig. 138). Fore wing with short marginal vein widening distally, stigmal vein curved on its upper margin and longer than short postmarginal vein.

Gaster of female very nearly sessile (petiole barely visible dorsally), about as long as thorax, convex or compressed; fourth tergite much longer (*F. curtivena*) or hardly longer (*F. gambiensis*) than the third; epipygium short. In male petiole longer than hind coxa.

Comments. — This is another peculiar group, in some ways again intermediate between *Eurytoma* and *Sycophila*. Although at present *Eurytoma* includes a whole range of sometimes very different species-groups, they all differ from *Ficomila* at least in the venation, especially in the postmarginal vein, which is always relatively longer, and also in the occipital characters. By the genae, scrobes and the venation *Ficomila* approaches more *Sycophila*, but in that genus, although its limits were slightly extended recently (Bouček, 1974: 267—268), the mesosternal region of the thorax is remarkably uniformly shaped, without any separation of the “mesosternal shelf”, in contrast to *Ficomila*, as stressed in the key above.

The genus is represented in the material by two species: of these the type-species *F. curtivena* is known only in the females, the other, which I identify as *F. gambiensis* (Risbec), in both sexes. Because of certain doubts as to the identity of the latter species I designate the first as type-species.

***Ficomila curtivena* Bouček, spec. nov.**
(figs. 135—137)

Female. —1.7—2.5 mm. Black, but often with mouth margin, pronotum lateroanteriorly and subalar sclerite testaceous, sometimes pale brown spreads on lower face, eye orbits and most of pronotum, with vague spots even on sides of mesoscutum and base of gaster; legs and antennae mainly pale coloured or with parts infusate, beginning with coxae, then more or less femora and flagellum. Wings hyaline to whitish, veins yellowish.

Head with inner eye orbits converging upwards; a few hairs present between scrobes and ocellus. Relative measurements: breadth of head 92, length 51, height 72, frontovertex 51, POL 23, OOL 8, eye 43×38, malar space 27, scapus 34, flagellum plus pedicellus 80. Funicular segments 2 to 5 moderately transverse, each slightly shorter than pedicellus; first funicular segment swollen dorsally, about 1.4 times as long as broad.

Thoracic dorsum sculptured and about 1.57 (less than 1.6) times as long as broad; pronotum barely narrower than mesoscutum, relative length laterally 33 (compare head). Propodeal, upper diverging cross-carina ending by angular tooth sublaterally (there turning downwards); area anterior to carina subdivided by several longitudinal carinulae; in profile propodeum sloping at about 70° as to plane mesoscutum-scutellum. Fore and hind femora moderately thickened; hind tibia with a dorsal row of about 9 outstanding bristles, longest bristle about as long as 0.8 of tibial breadth. For fore wing venation see fig. 135.

Gaster (fig. 136) smooth; slightly compressed from sides, dorsum only weakly convex; fourth tergite about twice as long as the third, bearing one cross-line of hairs which is broadly interrupted dorsally. Apex slightly up-turned.

Male. — Not known (one male which might belong to this species, cannot be at present separated reliably from those of *F. gambiensis*).

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, ex *F. burkei* (*natalensis*), 26.xi.1974 (A. Watsham); in BMNH, London. Paratypes: same origin as holotype, 22 ♀, xi.-xii.1974, iii. and ix.1976, iii.1977; Makumbi Mission nr. Salisbury, 4 ♀, iv.1975 and xii.1976 (all A. Watsham). South West Africa: Gross Otavi, ex *F. petersii*, 4 ♀, xi.1973 (A. Watsham). Paratypes deposited in RMNH, Leiden and in the Watsham collection.

***Ficomila gambiensis* (Risbec) comb. nov.**

(figs. 131—134)

Decatoma gambiense Risbec, 1955b: 561—564. Holotype ♀, Gambia. Mocquerys (MNHN, Paris) [examined].

Female. — 2.1—3.2 mm, holotype 4 mm. Usually honey yellow, flagellum and gaster slightly darker, tiny dark spots at ocelli; in holotype thorax except pronotum and almost whole gaster dark, blackish, in dark-coloured southern specimens whole body with all coxae almost black, only sides of pronotum and base of gaster ventrally paler, femora partly infusate. Fore wing always with distinct macula, normally small, but somewhat expanded below level of stigmal vein in holotype.

Head dorsally about 1.8 times (1.75—1.85×) as broad as long, with only slightly receding temples, hence appearing rather quadrangular. Scrobes ending one diameter from ocellus. Antenna: flagellum plus pedicellus less than 1.1 times as long as breadth of head; pedicellus nearly as broad as the broad-filiform funicle and distinctly shorter than its first segment (fig. 132) which is as if swollen on dorsal side and slightly concave ventrally where short hairs replace longitudinal sensilla; this segment about twice as long as broad in large holotype but usually relatively shorter in smaller specimens.

Thorax about 1.75 times as long as broad. Pronotum shallowly emarginate posteriorly. Outline of propodeum in profile straight; neck distinct. Marginal vein of fore wing slightly more widening (fig. 131) than in *F. curtivena* (fig. 135).

Gastral body slightly longer than thorax (fig. 133), fairly strongly compressed from sides, but dorsal keel rather blunt; hypopygium reaching about one-quarter along convex ventral edge.

Male. — Size and colour range about as in female (except holotype). Scapus distinctly broadened in basal two-thirds (fig. 134); pedicellus much shorter than first funicular segment which is dorsally swollen and bears short hairs in subconcave basal part ventrally, similar to female. Fore wing strongly hairy in basal part, unlike in female, marginal vein moderately to very strongly thickened. Petiole dorsally slightly shorter than scutellum, narrowed anteriorly, about 3.5 times as long as broad.

Material (apart from holotype). — Gambia: Fajara, 2 ♀, i.1978 (L. Huggert). Uganda: Kawanda, ex *Ficus sycomorus*, 1 ♀, ii.1939 (T. H. C. Taylor). Zimbabwe-Rhodesia: Chishawasha and Makumbi Mission nr. Salisbury, mostly ex or on *F. burkei*, 50 ♀ and 23 ♂, 1970—1977 (A. Watsham). South West Africa: Gross Otavi, ex *F. petersii*, 3 ♀, 6 ♂, xi.1973 (A. Watsham). South Africa: Hartebeeste Poort Dam, 1 ♀, viii.1974 (A. Watsham).

Comments. — This is apparently a widespread African species which I hope I have correctly interpreted, although in the wide variation of the specimens actually none is extremely similar to the holotype. However, the difference seems to be due mainly to the unusual size of the holotype.

Certainly of interest is the fact that this species was found associated with at least three different fig species, which again must reflect in some variation, apart from the geographical range from Gambia to Uganda and South Africa.

Sycophila Walker

Type-species: *Sycophila decatomoides* Walker.

The genus *Sycophila* Walker was earlier known under the name *Decatoma*, but this name given by Spinola was later recognised, according to its type-species, as a junior synonym of *Eurytoma* Illiger. *Decatoma* was then replaced by *Eudecatoma* Ashmead, until this name itself was synonymised, together with *Tineomyza* Rondani, under *Sycophila* (by Bouček, 1974). The synonymy slightly widened the earlier concept of the genus (earlier based only on North American and European species), mainly as to the length of the gastral petiole and the form of the expanded marginal vein. These characters vary considerably within the genus, especially in many tropical species partly or mostly associated with galled figs. Even now, however, *Sycophila* is one of the better delimited genera of the whole subfamily Eurytominae. It includes species of relatively usual eurytomid shape of body, with the gena posteriorly more or less edged but never sharply carinate; the scrobes deep, the parascrobal areas flat or slightly convex; antennae in female with five free funicular segments (11153), in male with four funicular segments (11143), without whorls of bristles. The marginal vein of fore wing is more or less widened (varying as to species and sometimes also as to sexes: more widened in males) and very nearly always bearing an infusate spot which sometimes extends below the vein. The propodeum has always a median depression which, especially if it is shallow, is anteriorly delimited by slightly oblique cross-carinae diverging from the middle of the base (anterior margin). Otherwise the gaster in the males is always petiolate, in the female the petiole is sometimes shortened. Legs usually normal, but in some species, especially in the males, mainly fore and hind femora are thickened, often strongly so.

The intraspecific variation, especially of size and colour, is frequently wide. Some species vary from completely yellow to completely black, but in the partly pale specimens a certain pattern can be recognised. The size affects also sculpture and density of pubescence. Some of the variation is certainly connected with temperature and humidity, some is more host-dependent or climatic and may offer a geographic pattern. Apparently at least some *Sycophila* are not host-specific and it seems that the host range of some species may be fairly wide.

List of described African and Malagasy species of *Sycophila*:

Sycophila aethiopica (Silvestri, 1915) comb. nov. (from *Decatoma*), Eritrea

Sycophila cassinopsisi (Risbec, 1952) comb. nov. (from *Decatoma*), Madagascar

Sycophila hilla Watsham (1977), Zimbabwe-Rhodesia

Sycophila kestraneura (Masi, 1917) comb. nov. (from *Decatoma*), Seychelles

Sycophila nigrofasciata (Risbec, 1952) comb. nov. (from *Decatoma*), Madagascar

Sycophila ruandensis (Risbec, 1957) comb. nov. (from *Decatoma*), Rwanda
Sycophila rubra (Risbec, 1952) comb. nov. (from *Decatoma*), Madagascar
Sycophila xiphigaster (Risbec, 1955c) comb. nov. (from *Decatoma*), Kenya

Dr. J. R. Steffan of the Paris Museum (MNHN) kindly enabled me to examine most of Risbec's species. One of them, *S. ruandensis*, is extremely close to *S. aethiopica*, of which I could examine a syntypic couple coming from Nefasit, Eritrea, thanks to Prof. Dr. G. Viggiani of Portici: the female is here designated (and was accordingly labelled by me) as lectotype. The two may be just forms of one species, the main difference being more compressed female gaster in *aethiopica*, apart from colour and extension of the sub-parastigmal patch of hairs, which is certainly prone to intraspecific variation. Also, *S. aethiopica* seems to be distributed over most parts of Africa. Most of these species are probably never associated with figs, only *S. kestraneura* apparently is, and probably also *S. xiphigaster*. The newly described species are compared with the old ones wherever it is relevant.

Decatoma plectroniae Risbec (1952) from Madagascar does not belong to *Sycophila*. It has a percurrent carina bordering the gena and temple posteriorly.

***Sycophila kestraneura* (Masi)**
(figs. 142, 143; pl. 4 fig. 5)

Decatoma kestraneura Masi, 1917: 138—139. Holotype ♀, Seychelles (BMNH, London) [examined].

This seems to be a very variable species and it took me a long time to recognise it from the small holotype specimen (in BMNH), a dwarf as I now believe, from the Seychelles Islands. A redescription seems necessary.

Female. — 2.1—3.0 mm. Usually yellow with poor blackish markings in median line of body, including ocellar area, occiput, median streak on thorax expanding on base of propodeum to inside of wing bases, petiole and dorsal keel of gaster. This pattern may be either reduced or slightly extended. Fore wing with elongate fuscous spot on swollen marginal vein, spot expanding slightly below the vein in large darker specimens.

Head dorsally about 1.85 times as broad as long; relative measurements: breadth of frontovertex 27.5, short oval eye 21×18 , malar space 13.5. Scrobes ending about half diameter from ocellus; interantennal keel narrow and not protruding, rather gradually sloping into scrobal cavity. Flagellum plus pedicellus barely longer than breadth of head, subclavate (fig. 142); pedicellus about 1.4 times as long as broad, narrower than basal funicular segments first of which is usually about 1.8 times as long as broad and distinctly longer than pedicellus (and bearing two rows of longitudinal sensilla), the fifth quadrate; clava about twice as long as broad.

Pronotum nearly as broad as mesoscutum, its sides in dorsal view moderately rounded. Umbilicate punctures on thorax usually fairly dense, but less so in smaller specimens. Axillar grooves anteriorly wide apart, only slightly inside of notauli: base of scutellum slightly broader than each axilla. Propodeum with conspicuous anterior converging keels, anterior to them (submedially) with

broad irregular areolae; median part shallowly convex, broad, anteriorly often with indication of median carina; posterior quarter, to one-third, narrowed, neck-like. Legs relatively slender, more slender than in *S. naso*. Fore wing pubescence rather reduced, dorsal surface basally extensively bare, occasionally with 1 or 2 hairs on basal fold; costal cell dorsally bare, on ventral surface generally with one row of hairs in proximal third, expanding to about 3 irregular rows distally; marginal vein distinctly longer than the subhyaline stigmal vein, swollen, its lower margin convex (fig. 143).

Petiole 1.5—1.8 times as long as broad (dorsally); gastral body fully as long as thorax, smooth, strongly compressed from sides, with distinct dorsal keel. Hypopygium ending shortly before middle of gastral body, its apex with usually two pairs of hairs.

Male. — 1.5—3.4 mm. Small specimens often similar to female in colour, but all differ mainly in antennae, fore wing pilosity and veins, and in gaster. Dark colour often spreads with larger size, including fore wing macula which may then be combined with brownish infumation of the blade proximad and distad of speculum; also femora get much stouter with larger size.

Scapus and pedicellus hardly different from female, but flagellum is filiform, itself (less pedicellus) distinctly longer than breadth of head; all funicular segments elongate, with rather dense subdecumbent hairs, first segment cylindrical, always much longer than pedicellus, in larger specimens fully twice so; following three segments subequal, each fully twice as long as broad; clava nearly four times as long as broad. Pronotum expanding forwards in larger specimens. Fore wing pilosity dense, long, extensive, especially long in basal part; in small specimens marginal swelling not much larger than in female but in larger specimens becoming more conspicuous, broader and further accentuated by expanding infuscation which may become higher than broad, as in pl. 4 fig. 5, which also shows the form of gaster, including the rather slender curved petiole which is slightly longer than the scutellum.

Material. — *S. kestraneura* was reared from figs of *Ficus burkei* in Zimbabwe-Rhodesia, from *F. petersii* in South West Africa (Gross Otavi, xi.1973, A. Watsham), from unidentified figs in Uganda (Kawanda, ii.1939, T. H. C. Taylor) and collected also in South Africa: Pondoland, Port St. Johns, v.1923 (R. E. Turner). In Zimbabwe-Rhodesia the collected or reared material comes from Chishawasha and Makumbi Mission nr. Salisbury and the Chinamora Reserve (all A. Watsham).

Comments. — In Africa there seems to be another species very close to *S. kestraneura* (Masi), with similarly shaped marginal vein but shorter funicular segments and the hypopygium (in female) fairly long. Otherwise *S. kestraneura*, among the African species, seems to be the one most closely related to the type-species of the genus *S. decatomoides* Walker from India.

***Sycophila punctum* Bouček, spec. nov.**
(figs. 144, 145)

Female. — 1.8—3.1 mm (holotype 2.5 mm). Usually predominantly black,

with pronotum on shoulders broadly pale yellow, also antennae pale yellow; hind coxa, femur and tibia mainly infuscate, on mid and especially fore legs pale colour more extended; sometimes head yellowish, mainly ventrally, rarely also most of pronotum, legs and even parts of ventral thorax and gaster anteriorly pale. Wings hyaline, with fuscous spot small and usually round, not reaching pale base of marginal vein.

Head finely reticulate, without umbilicate punctures; white pubescence unusually short, subdecumbent, longer and more erect only at mouth margin. In dorsal view head about 1.6–1.68 times as broad as long, with lateral ocellus nearer to eye than to median ocellus; the latter fully by its diameter from scrobes; interantennal crest not high but slightly tooth-like. Relative measurements: head width 47, length 28.5, height 37, frontovertex 25.5, eye 23×19 , malar space 12, scapus 19, flagellum plus pedicellus 46. Centres of antennal toruli on lower ocular line. Pedicellus 1.7–1.8 times as long as broad, at least slightly longer (but not broader) than first funicular segment which is usually 1.5 times as long as broad. Flagellar segments stout-filiform, preclaval one often quadrate; flagellar pubescence subdecumbent.

Sculpture on thorax fine dense reticulation, surface not shiny; puncturation obliterated, pubescence white, short and almost decumbent, absent from central area of scutellum. Anterior edge of lateral panel of pronotum usually finely carinate. Propodeal surface in profile convex in upper one-third. Hind tibia with a row usually of 7–10 dorsal bristles, middle ones longer than half breadth of tibia. Fore wing with basal third bare (as in *kestraneura*); marginal vein gradually expanding, relatively short, about as long as the stigmal (fig. 145).

Gastral petiole dorsally (measured as usual from anterior cross-ridge) subquadrate. Body of gaster about as long as thorax less propodeum, distinctly compressed, tergites 3 to 5 distinctly keeled, fourth slightly longer than third and with one short row of sparse hairs on either side; tergites with extremely fine and shallow cross-striae.

Male. — 1.9–2.5 mm. Head extensively to completely yellowish; pronotum dorsally yellow, except median triangle, but lower part of lateral panel abruptly black, often other parts of thorax pale. Head very stout (fig. 144), but variable, 1.35–1.55 times as broad as long in dorsal view. Antennal toruli entirely below lower ocular line. Pronotum distinctly longer than in ♀, its collar fairly flat, about 1.5 times as broad as laterally long. Fore and hind femora distinctly thickened. Fore wing macula in one specimen extended down as curved streak. Gastral petiole stout in lateral view, dorsally finely reticulate and about 2.1 times as long as broad, slightly tapering forwards.

Type material. — Holotype ♀ (plus 7 ♀ and 1 ♂ paratypes), Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, ex *F. burkei*, iv.1975; then 6 ♀ paratypes, xii.1976 (all A. Watsham); deposited in BMNH, London. Further paratypes: Chishawasha nr. Salisbury, 73 ♀ 2 ♂, 1969–1977, mostly ex *F. burkei*; St. Pauls Mission, 1 ♀, i.1975 (A. Watsham). Some paratypes are deposited in RMNH, Leiden and in the Watsham collection.

Comments. — *Sycophila punctum*, as stressed in the key, is recognisable mainly on its pilose prepectus (fig. 144), further in the female on the usually predominantly black colour with large pale spots on pronotal shoulders, small wing macula and a stout head. The head apparently becomes stouter in larger males, also the wing macula may be expanded. It is striking that so few males were reared or collected, although in this species they seem to be quite safely recognisable.

***Sycophila sessilis* Bouček, spec. nov.**
(figs. 146, 148, 149)

Female. — 2.0—2.7 mm. Colour as in paler specimens of *S. punctum*, i.e., with pale yellow shoulders but yellowish colour otherwise spread also over most parts of body, but flagellum slightly brownish.

Head dorsally slightly less than 1.8 times as broad as long. Interantennal ridge gradually descending into scrobal cavity. Relative measurements: head width 48, frontovertex 25, eye 19.5×17 (smaller than in *punctum*), malar space 13.5, scapus 20, flagellum plus pedicellus 51. All funicular segments elongate, the first very slightly longer than pedicel (fig. 149).

Umbilicate punctures on thorax shallow and not very dense, but fairly distinct, pubescence longer than in *S. punctum*. Exposed part of prepectus bare, occasionally with 1 or 2 hairs. Fore wing with sparse bristles on basal fold, rarely with only two or three; fuscous macula similar to that of *S. punctum* but marginal vein longer (fig. 146).

Gastral petiole dorsally much broader than long, gaster almost sessile; its body about as long as thorax, more strongly compressed than in *S. punctum*, surface smooth.

Male. — Not known.

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, ix.1974 (A. Watsham); in BMNH, London. Paratypes: Chishawasha, partly ex *F. burkei*, 7 ♀, ix.1970, ix.—x. 1974, iii. and vii.1975, vi.1977 (A. Watsham); South Africa: Pondoland, Port St. Johns, 1 ♀, ii.1924 (R. E. Turner).

Comments. — The species should be recognisable from the key and the additional characters in the description. However, I could not find any males which I could safely associate with the females of *S. sessilis*.

***Sycophila modesta* Bouček, spec. nov.**
(fig. 147)

Female. — 2.2—2.6 mm. Predominantly yellow, with tiny dark spots at ocelli and brown colour on flagellum, pedicellus, median part of propodeum, petiole, broad bands at hind margins of first three tergites, sides of fourth tergite and apical half of hind tibia. Dark markings may be slightly reduced or expanded.

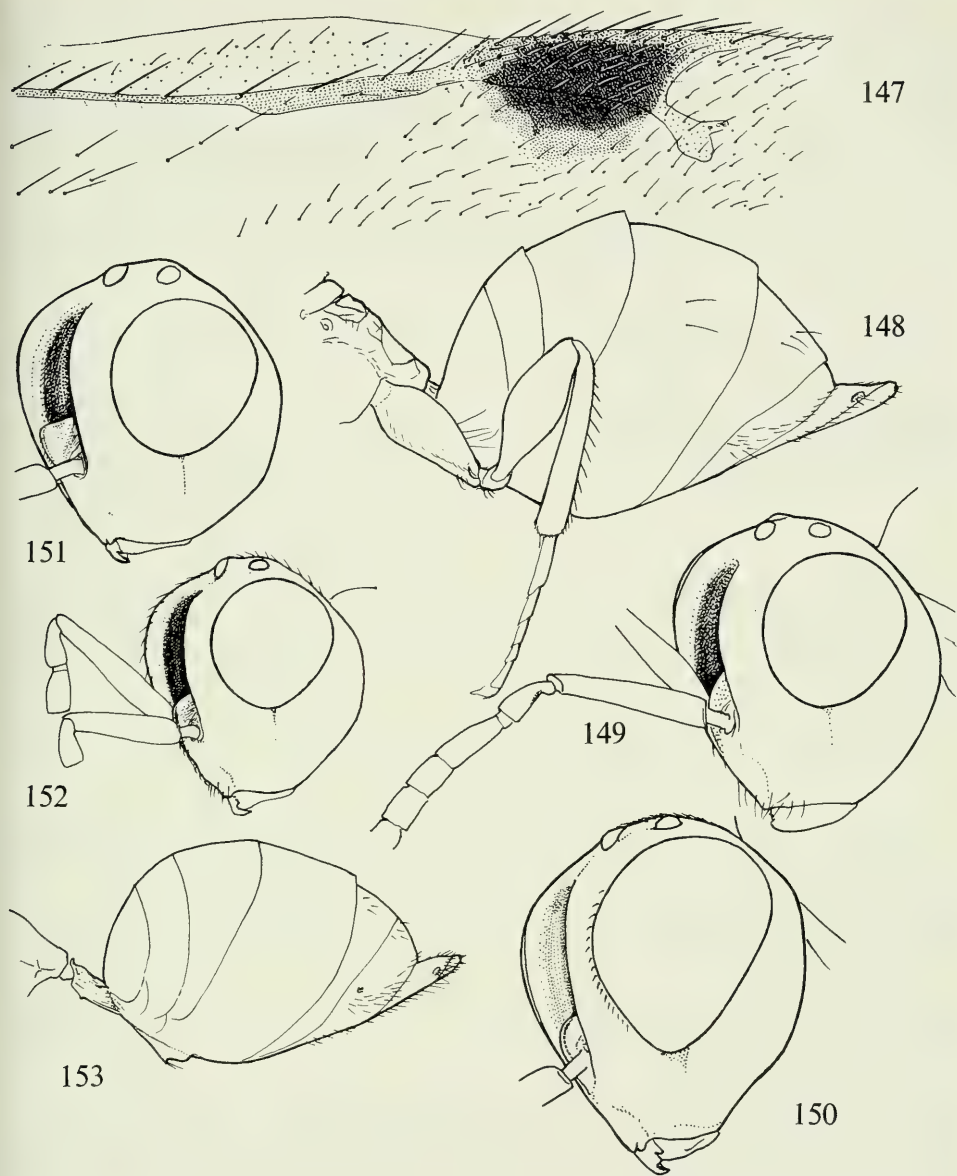


Fig. 147. *Sycophila modesta* Bouček, spec. nov., venation of female fore wing. Figs. 148, 149. *Sycophila sessilis* Bouček, spec. nov., female. 148, propodeum, gaster and hind leg; 149, head, tilted lateral view. Fig. 150. *Sycophila flaviclava* Bouček, spec. nov., female head in tilted lateral view. Figs. 151–153. *Sycophila naso* Bouček, spec. nov., female. 151, head in a larger specimen with a more rectangular interantennal lobe; 152, head in a smaller specimen with more rounded interantennal lobe; 153, gaster.

Wing macula (fig. 147) as in *S. naso*.

In colour, size, sculpture, pubescence of fore wing and length of petiole very similar to *S. naso*, but for following characters. Lateral ocellus slightly nearer to

eye than to median ocellus, interantennal ridge only gradually sloping into scrobes; pedicellus up to 2.2 times as long as broad, subequal in length to first funicular segment; scutellum slightly broader at base (border with mesoscutum); propodeum rather flat in median part, ground nearly smooth, wide-areolate, with stronger carinae delimiting a pentagonal area, with a cross-carina separating the neck; costal cell dorsally in distal half usually with distinct line of erect hairs (fig. 147; rarely reduced to several hairs only). Body of gaster broader and shorter, only moderately compressed from sides, not distinctly keeled dorsally.

Male. — Not known (I am not sure about their specific identity).

Type material. — Holotype ♀ (plus 1 ♀ paratype), Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, ex *F. burkei*, xii.1976 (A. Watsham); in BMNH, London. Further paratypes: Chishawasha nr. Salisbury, mostly ex *F. burkei*, 12 ♀, ix. and xi.1974, iii. and vi.1975, xii.1976, vi.1977 (A. Watsham).

Comments. — This species seems to be safely recognisable in the females, although similarly coloured females of other closely related species, e.g., of *S. naso*, may occur. The wing pilosity seems to be a good character, but not for the males in which larger and darker specimens of the same species often exhibit much greater density of pubescence, along with broader veins, femora, etc.

***Sycophila naso* Bouček, spec. nov.**
(figs. 151—153)

Female. — 2.3—3.5 mm (holotype 2.8 mm). Body usually yellow (as in holotype) but colour variable: dark colour appearing first in a streak on dorsal keel of gaster, then at ocelli, on lower occiput, pronotal collum, on deeper parts inside wings, some specimens have also darker mesoscutum anteriorly and scutellum posteriorly, in extreme case whole gaster and underside of thorax including propodeum are dark, also partly mid and hind legs; flagellum brownish; fore wing with dark elongate spot on marginal vein, with about half of macula (or more) below the vein.

Puncturation, especially on thorax, rather dense and conspicuous; pubescence moderately short but distinct. Head dorsally about 1.75 times as broad as long, with temples rather strongly receding; POL nearly twice OOL; lateral ocellus hardly nearer to median one than to eye; scrobes ending by blunt edge about half diameter before ocellus; interantennal keel high, fairly broad ventrally, dorsally forming a distinctly protruding subrectangular tooth (figs. 151, 152; hence the name, *naso* = nose). Parascrobal area subequal in breadth to scrobes at level where its straight edge turns towards ocellus. Pedicellus dorsally fully twice as long as broad (17 : 7), slightly to obviously longer than first funicular segment (17 : 15 in holotype), its dorsal side nearly straight; fifth funicular segment slightly elongate; clava about 2.5 times as long as broad.

Thorax about twice as long as broad (mesoscutum); pronotum slightly widening forwards, with subrectangular protruding corners, laterally longer than in

middle; lateral panel not distinctly carinate anteriorly. Mid lobe of mesoscutum posteriorly narrow, scutellum still more narrowed anteriorly, axillae little apart. Propodeum shorter than scutellum (about 3 : 4); its median depression shallow; anterior diverging keel distinct, pentagonal median area subdivided into irregular areolae. Metasternal region medially usually with three distinct carinae converging caudad into one. Legs fairly slender. Fore wing with distinct line of bristles on basal and most of cubital fold, usually also some bristles on basal cell (as in fig. 147); costal cell with numerous short hairs on ventral surface but dorsal surface bare, occasionally with one hair; marginal vein broadening distad, its lower margin almost straight.

Gastral petiole dorsally fully 1.5 times as long as medially broad (20 : 13 in holotype), sides subparallel. Gastral body (fig. 153) slightly longer than thorax (including propodeum), fairly strongly compressed from sides, dorsally with blunt but distinct keel; epipygium very shortly protruding, usually also tips of sheaths visible; tergites 1 to 5 virtually bare and smooth. Hypopygium (not always visible) rarely exceeding basal quarter of gaster, at apex with two thin long bristles, before them a pair of shorter hairs.

Male. — In size and colour and in most characters very similar to female. Pedicellus dorsally about 3 times as long as broad, almost as long as, to slightly longer than, first funicular segment (anellus excluded), latter slightly longer than any of following three subequal segments; flagellum almost filiform, clava as long as two preceding segments combined. Basal third of fore wing with many more hairs than in female, hairs much denser in bigger and darker specimens; ventral surface of costal cell with extremely dense short pubescence, distal half of dorsal surface with a row of hairs which is usually partly doubled. Lower margin of marginal vein almost straight (but looking slightly convex in certain lights in darker specimens), relatively longer than in *S. kestraneura*, about twice as long as the pale stigmal vein which is subparallel to front margin of wing; greater part of fuscous macula often below the vein. Petiole dorsally slightly shorter than scutellum.

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, ex galls on *F. burkei*, v.1975 (A. Watsham); deposited in BMNH. Paratypes: same origin as holotype, 65 ♀ and 52 ♂, ix.—xii.1974, ii., v.—xi.1975, ii.—iii.1976, i.1977; Makumbi Mission nr. Salisbury, 1 ♀, iv.1975 (all A. Watsham); Uganda: Kampala, ex galls on stem of *Ficus sycomorus*, 2 ♀, 8.x.1935 (T. H. C. Taylor); South West Africa: Gross Otavi, ex *F. petersii*, 1 ♀, xi.1973 (A. Watsham). The females of the Chishawasha material emerged between May and July are yellow-coloured, those emerged between September and March are dark-coloured, whilst the dark males appear throughout the year, although the yellow ones only together with yellow females. Some paratypes in RMNH, Leiden and the Watsham collection.

Variation. — Apart from the range of variation already mentioned I find some puzzling features in some further specimens (not included in the type material of *naso*). In a few females the pedicellus is relatively shorter (fig. 152) and so it is in a

number of males. I wonder whether still another species may be involved, but as to the males, some of them may belong also to *Sycophila sessilis* or *S. modesta*, whose males are not yet known for sure.

Comments. — *S. naso* is recognisable mainly on the relatively long and slender pedicel (in both sexes), the strongly converging axillar grooves and the small wing macula on the straight lower margin of the marginal vein. Furthermore the female has a fairly long gastral petiole and hairy proximal part of the fore wing, but virtually no hairs on the dorsal surface of the costal cell.

Another similar species is *Sycophila cassinopsisi* (Risbec), comb. nov. originally described in *Decatoma* (Risbec, 1952: 278—281) from Madagascar. Dr. J. R. Steffan from the MNHN, Paris, kindly sent me the type material for examination. I remounted most of the syntypes on cards and designated one female (emerged 6.iv.1950) as lectotype and labelled accordingly. *S. cassinopsisi* is smaller but less slender than *S. naso*, has the puncturation on thorax much more obliterated, the head is stouter, about 1.5 times as broad as long (dorsally 70 : 47), the sides of pronotum are parallel, the collar is regularly convex, in middle almost as long as at sides, the pedicellus is distinctly broader than the proximal half of flagellum and much longer than the first funicular segment. The fore wing pubescence is short and rather reduced towards base, with only few hairs on basal fold. The gastral body of female is relatively short (not the petiole) and not keeled dorsally. By the stouter head it reminds one somewhat of *Sycophila punctum*, but that species differs greatly in colour, the pilose prepectus, the shorter marginal vein and petiole, etc.

***Sycophila flaviclava* Bouček, spec. nov.**

(fig. 150; pl. 4 figs. 3, 4)

Female. — 2.0—3.2 mm (holotype 3.2 mm). Predominantly yellow, with small black spots at occipital foramen, base of fore coxa, mid part of prepectus (normally concealed), a T-shape pattern on propodeum, metasternum and petiole; sometimes dark colour more spread, or less so (pl. 4 fig. 3); flagellum slightly infusate but most of clava (except base) yellow (hence the name).

Head shaped about as in *S. naso* but white pubescence distinctly denser, shorter and more decumbent (this to lesser extent also on thorax); lateral ocelli slightly nearer to eye than to median ocellus; eye distinctly larger than in *S. naso* and its lower extremity distinctly subangular; parascrobal areas relatively narrower, also temples and genae; interantennal crest descending slightly obliquely into scrobes; antenna very slightly clavate, pedicellus dorsally only 1.75 times as long as broad and slightly shorter (7 : 8 in holotype) than first funicular segment. Relative measurements: head breadth 54, length 30, height (with clypeal lobes) 45, frontoververtex breadth 29, eye 29×21.5 , malar space 14, scapus 24, flagellum plus pedicellus 52.

Thorax slightly more robust than in *S. naso*; median part of metasternum in profile angular at level of anterior edges of hind coxae; metanotal hairline dense.

Gastral body distinctly less compressed than in *S. naso*, slightly shorter than thorax less propodeum; dorsally not keeled.

Male. — 2.7 mm. Colour (pl. 4 fig. 4) about as in holotype ♀ but flagellum not paler apically, pubescence slightly longer and more erect. Longest eye diameter in ratio to malar space as 23 : 13; pedicel dorsally twice as long as broad, scarcely longer than fourth funicular segment. Pronotum posteriorly hardly emarginate, this margin subparallel to anterior edge of collar; black petiole dorsally fully three times (28 : 9) as long as broad.

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, ii.1977 (A. Watsham); in BMNH, London. Paratypes: same origin as holotype, partly reared from *F. burkei* galled figs, 9 ♀, 1 ♂, ix.—xi.1974, iii. and v.1975 and (1 ♀ + 1 ♂) iii.1976; Makumbi Mission nr. Salisbury, 1 ♀, xii.1976 (A. Watsham).

Comments. — The description is based on difference between *S. flaviclava* and *S. naso*. Both species belong to a group of closely related species which might be called the *naso*-subgroup and includes also *S. modesta* and *S. sessilis*, whilst the other two species treated here in detail, *S. punctum* and *S. kestraneura*, belong to other subgroups.

ORMYRINAE

Ormyrus Westwood

Type-species: *Ormyrus punctiger* Westwood; by monotypy.

The species of this group possess a strongly sclerotised gaster, often bearing characteristic rough sculpture (figs. 155—157). This sculpture (although not present in all species) combined with the obliterated notaular grooves and the virtually non-exserted ovipositor with which again a reduction of the epipygial cerci (to low tubercles) is correlated, were regarded recently as important enough to warrant the group a family status, i.e., independent of Torymidae. Riek (1970: 921) even transferred them, on the basis of the reduced cerci, as a subfamily to the Pteromalidae. However, an analysis of various critical characters seems to demonstrate strong links with Torymidae and thus they seem to be best placed as their subfamily, as they were mostly in the past.

Several generic names have been proposed in this group, all based on the number of the reduced proximal segments of the flagellum (anelli) and partly on the gastral sculpture. As they do not denote any evidently natural groups, only one genus is recognised, *Ormyrus* Westwood.

All *Ormyrus* species have associations with plant tissues, especially galls, although a few species probably develop in grass stems. Their actual role within the galls is not yet known, although they are supposed to be at least partly entomophagous, parasitic, rather than feeding solely on plant tissues (see under *O. flavipes*, below).

Three species were found in association with the galled figs of *Ficus burkei*: *Ormyrus watshami* spec. nov., *O. subconicus* spec. nov. and *O. flavipes* spec. nov. Otherwise the following species have been described from Africa south of the Sahara and from Malagasy:

- O. australis* Risbec, 1957, from Madagascar
O. chevalieri (Risbec, 1955 b) comb. nov. (originally in *Monobaeus*), from Chad
O. decaryi (Risbec, 1955 a) comb. nov. (originally in *Tribaeus*), from Madagascar, but widely distributed in southern Africa including Zimbabwe-Rhodesia
O. eugeniae Risbec, 1955 a, from Madagascar
O. harongae (Risbec, 1952) from Madagascar, originally described in *Wania*, but transferred to *Ormyrus* by Risbec (1955a: 176) himself
O. ornatus (Risbec, 1951) from Senegal, originally described in *Wania*, but transferred to *Ormyrus* by Risbec (1954: 535)
O. sculptilis Crosby, 1909, from Malawi (formerly Nyasaland)
O. striatus Cameron, 1907, from South Africa (the single extant male type in BMNH, London, Type Hym. 5—64, is here designated lectotype).

The new species are compared with the earlier described species following a study of their types.

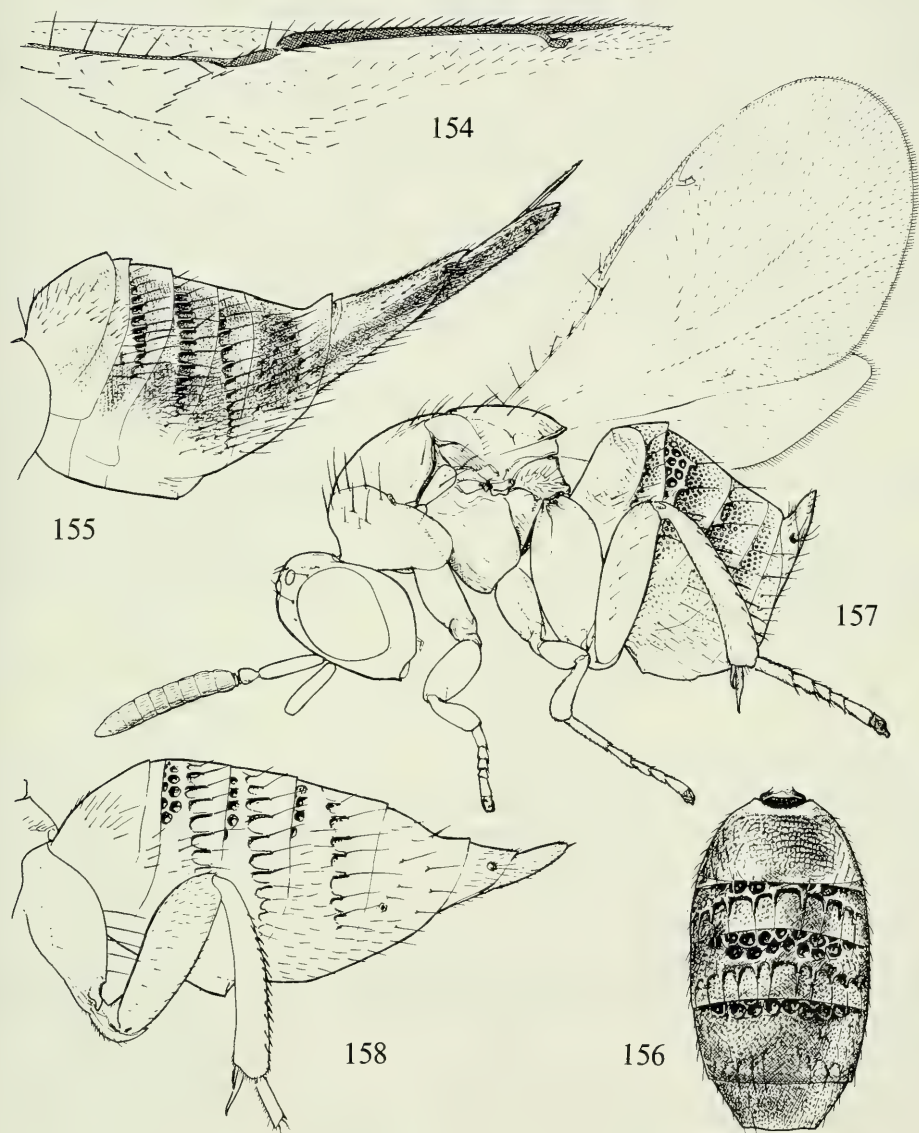
***Ormyrus watshami* Bouček, spec. nov.**
(fig. 157)

Female. — 1.7—2.0 mm. Bright metallic blue (mainly thorax) to green (vertex, occiput), dorsum of darker bluish gaster from apex of tergite 1 to base of tergite 3 black; antennae dark brown but scapes, fore tibiae, all tarsi, partly also knees, trochanters, mid tibiae and fore femora, testaceous. Wings hyaline.

Head fairly shiny, with sculpture weaker than in most known species of *Ormyrus*, on vertex consisting of curved engraved cross-striae; hairs on vertex reduced to one pair between posterior ocelli, two hairs at eye outside of posterior ocellus and one hair in front of this ocellus; piliferous punctures very conspicuous; parascrobal areas and lower face with very short and rather sparse white hairs. Anterior margin of clypeus short, bilobed, with median incision. Occipital carina situated low, near occipital foramen; a blunt edge slightly indicated not far behind posterior ocelli. Relative measurements: head width 85, height 67, length (thickness) 43, frons width 50, POL 24, OOL 8, eye 44×34 , malar space 16, scapus 28×7 , flagellum plus pedicellus 74. Pedicellus subglobose (beyond basal constriction); first anellus very thin, second larger but still more than 3 times as broad as long; all six funicular segments transverse, the first slightly so, the sixth twice as broad as long, each with one row of sensilla.

Thorax about 1.33 times as long as (mesoscutum) broad, strongly convex, shiny. Mesoscutum finely but not very densely cross-striate, mid lobe mainly bare, only posteriorly with 3—5 irregular pairs of bristles (fig. 157). Scutellum fully 1.1 times as long as broad, dorsally with concentric striae, with only 4 pairs of bristles leaving the disc broadly bare; apex of scutellar rim truncate-subemarginate and jutting out over the steep smooth propodeum; latter with numerous hairs on lateral callus. Mesopleuron almost smooth, bare; broad metapleuron with a few hairs. Dorsal edge of hind tibia with a row of about 10 strong bristles and more outside with another row of slightly shorter bristles; longer spur curved, its basal half distinctly hairy. Fore wing unusually sparsely pubescent, basal third including large speculum (which extends on dorsal surface to stigmal vein) bare, but usually with some hairs in place where basal fold approaches cubital fold.

Gaster not or hardly longer than thorax, fairly compressed from sides, with distinctly up-turned epipygium; tergites 2 to 5 with simple keel in median line. Hind margin of first tergite medially excised; second tergite short, punctured; third tergite longer, in basal half sublaterally with full 3 rows of coarse puncta (rows interrupted in median line), apex with simple puncturation (as most tergites); fourth tergite sublaterally hardly showing any puncta (they are mostly



Figs. 154—156. *Ormyrus flavipes* Bouček, spec. nov., female (154, 155) and male (156). 154, venation of fore wing; 155, gaster; 156, male gaster, dorsal aspect. Fig. 157. *Ormyrus watshami* Bouček, spec. nov., female. Fig. 158. *Ormyrus subconicus* Bouček, spec. nov., female gaster with hind leg.

concealed by third tergite). Hypopygium not prominent, not exceeding middle of gaster.

Male. — 1.6—1.9 mm. Bright brassy green but sides of thorax including tegulae testaceous, as well as all legs and antennal scapes; rest of antenna more brownish; usually also a broad indefinite cross-band on gaster just before middle testaceous.

Head and thorax very much as in female but anelli more conspicuous; fore wing pilosity denser and more conspicuous, speculum slightly reduced, reaching only two-thirds of marginal vein. Gaster flat, elongate, its sculpture generally weaker than in ♀; third and fourth tergites basally with large puncta (pits) arranged in very irregular rows, more than two of which are usually exposed on the third, and less than two rows on the fourth tergite.

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, ex *Ficus burkei* galls, xii.1976 (A. Watsham); deposited in BMNH, London. Paratypes: 18 ♀ and 25 ♂, same data as holotype; 5 ♀ and 3 ♂, Chishawasha nr. Salisbury, x. and xii.1974, iii. and v.1975, iii. and ix.1976, vi. and x.1977.

Comments. — *Ormyrus watshami* can be immediately recognised in both sexes by the reduced pilosity on the dorsum of the head and thorax, leaving the mid lobe of mesoscutum bare, except for a few hairs posteriorly. This is unique among all other known species of the genus. In addition, the female has a characteristic short form of the gaster (fig. 157) and the male is distinct by the combination of the gastral sculpture and the widespread pale colour of the body. Otherwise it belongs to the *punctiger*-group.

***Ormyrus flavipes* Bouček, spec. nov.**
(figs. 154—156; pl. 4 fig. 6)

Female. — 2.1—4.3 mm (holotype 4.1 mm). Bright metallic green, partly more golden, especially on genae and sides of pronotum, but on hinder part of thorax and its sides more bluish to violaceous; violaceous mainly on dorsal edge of hind coxa, on dorsal part of first tergite and on the coarsely sculptured basal parts of tergites 3 to 5; epipygium dark purpureous; testaceous are: antennal scapes, all legs including fore coxae and distal parts of mid and hind coxae, then tegula with subalar area, partly lateral panel of pronotum and underside of gaster from where the pale colour usually spreads broadly dorsad, at least along hind margins of tergites, especially the fifth and sixth; rest of antenna black. Wings hyaline.

Head and thorax dorsally fairly dull, generally cross-striate, rather densely clothed with subdecumbent pubescence. Piliferous punctures on vertex little conspicuous in dense cross-striation; an edge behind ocelli; occipital carina situated close to foramen. Face, except for the rather deep and smooth scrobes, with dense rugose striation; on lower face a slightly raised semicircular carina in half distance between toruli and mouth (separating also clypeus from supracly-

peal area), at sides ascending towards eye margins. Gena in a strip just behind malar groove very finely but distinctly striate; posteriorly striation much coarser. Lobes of clypeal margin low, separated by shallow emargination. Relative measurements: head width 111, height 83, length (thickness) 52, frons width 60, POL 24, OOL 12, eye 55×44 , malar space 24, distance between toruli and mouth margin 31, scapus 33×10 , flagellum plus pedicellus 101. Pedicellus dorsally nearly twice as long as broad (13 : 7); first anellus thin, second nearly half as long as broad; first funicular segment about 1.1 times, last (sixth) about 1.5 times as broad as long, each with dense row of sensilla; clava only 1.7 times as long as broad.

Thorax dorsally about 1.45 times as long as broad; its sculpture on mesoscutum consisting of cross-striation formed by numerous fine strips with mostly raised hind margins, with hairs arising on hind slope of raised margin. Scutellum about 1.15 times as long as broad, its apex rounded; anteriorly it is cross-striated with piliferous punctures, posteriorly striae are arranged concentrically. Propodeum subvertical, short, medially smooth, submedially alutaceous. Hind tibia dorsally with many rather short bristles which are only partly arranged in about three irregular rows. Fore wing with rather dense pilosity, cubital hairline reaching base of wing, basal hairline complete, basal cell with a dorsal row of bristles subparallel to submarginal vein; costal cell dorsally bare but ventrally with a hairline which is trebbled in distal third; stigma close and subparallel to postmarginal vein (fig. 154).

Gaster fully twice as long as thorax, fairly compressed from sides, with simple median keel distinct from tergite 4 to saddle of tergite 6 (fig. 155); distal third of gaster conical and moderately up-turned; tergites 3 to 5 each punctured, with basal part raised and ending by a vertical row of short ridges (each ridge with a bristle at caudal tip), virtually without any exposed foveae; on sixth tergite the ridges shortened into tubercles and additional weaker tubercles are scattered on basal part; ridges on fourth tergite mostly longer than distance between them. Sculpture as well as dimensions indicated in fig. 156.

Male. — 1.4–2.4 mm. Gaster wholly metallic, long oval (fig. 156), slightly longer than thorax to as long as head plus thorax combined; first tergite dorsally with broad-meshed reticulation; second very short; tergites 3 to 5 each with dark purple basal band of deep foveolae arranged in at least 2 rows, with smooth narrow interspaces.

Biology. — After finishing this paper one of us (A. W.) observed a white larva attached to the pupa of *Syceurytoma ficus* in a galled fig. He separated the parasitised pupa from the rest and after a few days the parasite pupated and proved to be *Ormyrus flavipes*.

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Chishawasha nr. Salisbury, ex *F. burkei* galls, vi.1975 (A. Watsham); deposited in BMNH, London. Paratypes: 16 ♀, 12 ♂, same data as holotype; 12 ♀ and 20 ♂, same origin, ii.—ix.1975, 1 ♂ ix.1976; 1 ♂ Makumbi Mission nr. Salisbury, xii.1976 (A. Watsham).

Comments. — Among the African species known to me (described or undescribed) several species belong to a species-group of *O. orientalis* Walker characterised by the double carina on at least some gastral tergites in the females, with generally rough sculpture of gaster in both sexes. From the African species listed above *O. eugeniae* Risbec, *O. ornatus* (Risbec) and *O. striatus* Cameron belong to this *orientalis*-group and can be therefore easily separated from *O. flavipes*. Another easily separable species is *O. decaryi* (Risbec) belonging to the species with no dorsal keel on the gaster in females. Our *O. flavipes*, with its simple keel on the female gaster, belongs to the group of *O. punctiger* Westwood (a European species), along with the African *O. chevalieri* (Risbec) and *O. sculptilis* Crosby, and the Malagasy *O. harongae* (Risbec). *O. chevalieri* is easily recognisable by its short rounded female gaster. *O. harongae*, of which I examined the two syntypes (mounted on a slide) thanks to my colleagues from the Paris MNHN, differs from *O. flavipes* mainly by the predominantly yellowish body with the apical part of the female gaster still more produced and with shorter ridges in rows on the tergites. On the other hand *O. sculptilis*, of which I was enabled to examine and remount the original material (thanks to my colleagues in the Cornell University in Ithaca) and selected and labelled a female in good condition as lectotype (here designated), has the conical apical part of the female gaster much shorter than in *O. flavipes*, and not up-turned. The male can be more easily confused and the assessment of its diagnostic characters has to await a revision of the African species.

***Ormyrus subconicus* Bouček, spec. nov.**

(fig. 158)

Female. — 1.7—3.3 mm (holotype 2.5 mm). Mainly bright green, sometimes slightly bronze or brassy, but on head and thorax often in places bluish to violaceous or even purpureous, on gaster foveolate bases of middle tergites usually dark violet or purpureous; scapes (except apically), tegulae, trochanters, knees and tarsi testaceous, but often pale colour spreading to whole tibiae and most of femora, then with only hind femora mainly metallic. Wings hyaline.

Sculpture and form of head and thorax much as in smaller specimens of *O. flavipes*, but lateral ocelli slightly nearer to eyes, POL nearly 3 times OOL; scapus slender, about 4 times as long as broad.

Gaster (fig. 158) about 1.3 times as long as head plus thorax combined, only slightly compressed from sides, with simple dorsal keel. Basal part of tergites 3, 4 and 5 with distinct exposed belts of foveolae, usually in two rows on each tergite; tergite 6 usually as long as the fifth, its saddle very shallow; epipygium much shorter than preceding sixth tergite, not or scarcely up-turned.

Male. — 1.4 mm. Very similar to male of *O. flavipes* but hind femur distinctly infusate, antennal pedicellus subglobose, i.e., beyond its basal constriction only slightly longer than broad (more evidently so in *flavipes*) and tergites 4 and 5 each with full two rows of basal foveolae (irregular and not fully two rows in *flavipes*, fig. 156).

Type material. — Holotype ♀, Zimbabwe-Rhodesia: Makumbi Mission nr. Salisbury, *F. burkei*, xii.1976 (A. Watsham); in BMNH, London. Paratypes: 1 ♀, same data as holotype; 9 ♀ and 1 ♂, Chishawasha nr. Salisbury, *F. burkei*, xi.—xii.1974 (A. Watsham).

Comments. — This species also belongs to the *punctiger* species-group and, being close to *O. flavipes*, the above description stresses the diagnostic characters in relation to that species. This species-group is rich in species in Africa. Among the previously described species the nearest is *O. sculptilis* Crosby which differs from *O. subconicus* mainly in the still less saddled sixth tergite in the female, with longer fifth tergite exposing usually three regular rows of foveolae (in this it differs also from *O. flavipes*). I find these more extensive foveolate bands also in two males reared from figs of *F. petersii* in South West Africa and therefore regard them as probably specifically different from *O. subconicus*. It seems that as to the host-specificity possibly *O. watshami* is a typical fig-associated species, whilst *O. flavipes* and *O. subconicus* may develop also in some other galls or gall-like plant parts. However, the questions of the host-specificity have been hardly considered in the African chalcids so far.

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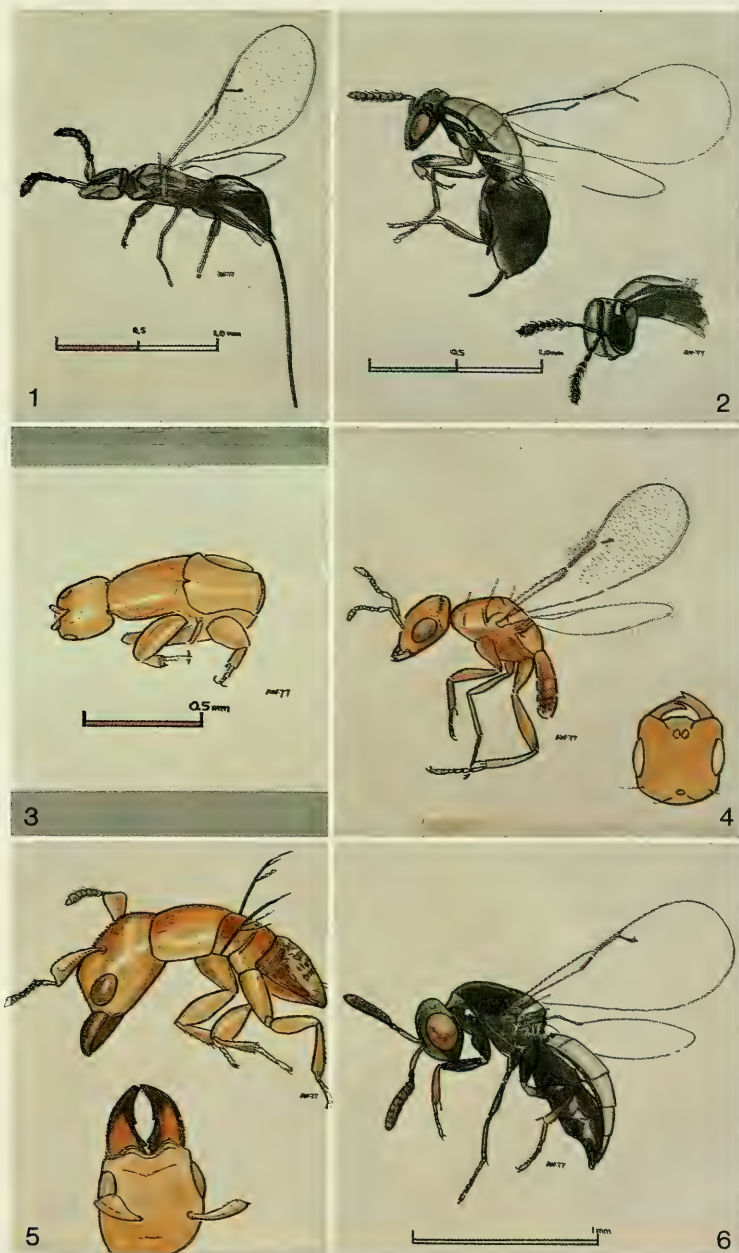


Fig. 1, *Elisabethiella stuckenbergi* (Grandi), female; 2, *Crossogaster odorans* Wiebes, spec. nov., female; 3, *Elisabethiella stuckenbergi* (Grandi), male; 4, *Crossogaster odorans* Wiebes, spec. nov., male; 5, *Otitessella tsamvi* Wiebes, spec. nov., male; 6, do., female.

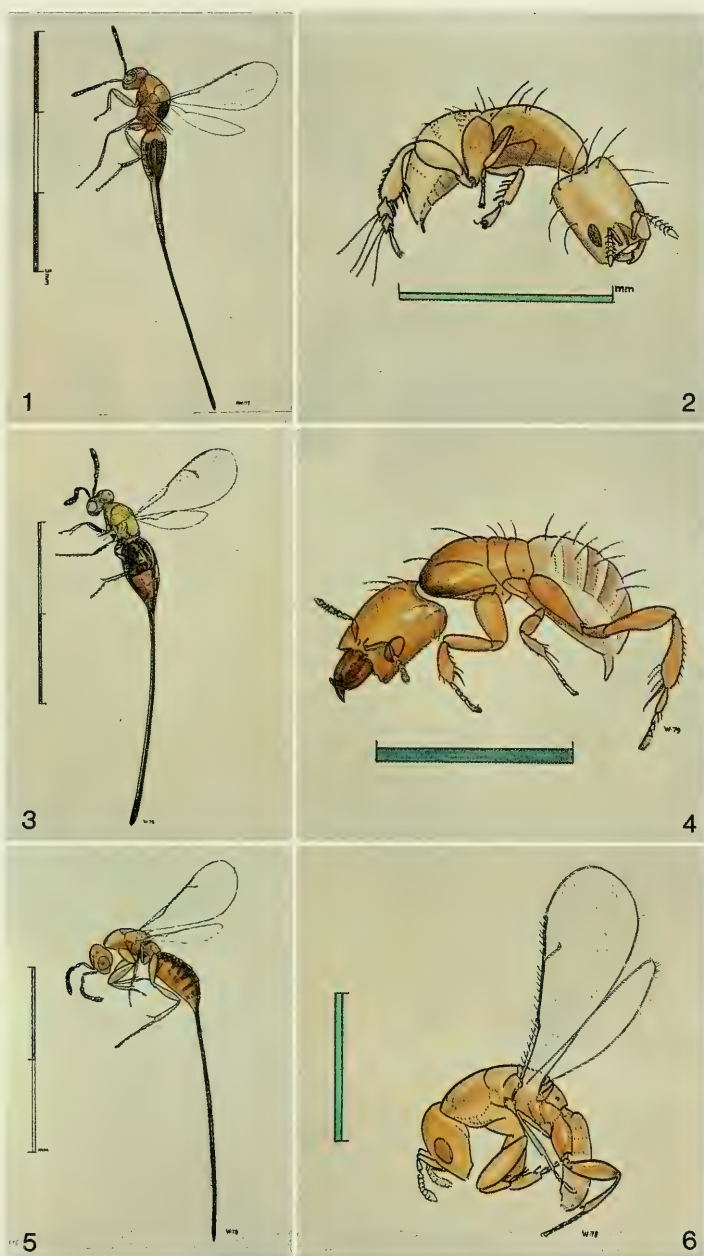


Fig. 1, *Philotrypesis parca* Wiebes, spec. nov.; 2, do., male; 3, *Sycosapter cornutus* Wiebes, spec. nov., female; 4, *Sycoryctes remus* Wiebes, spec. nov., male; 5, *Watshamiella alata* Wiebes, gen. et spec. nov., female; 6, do., male.

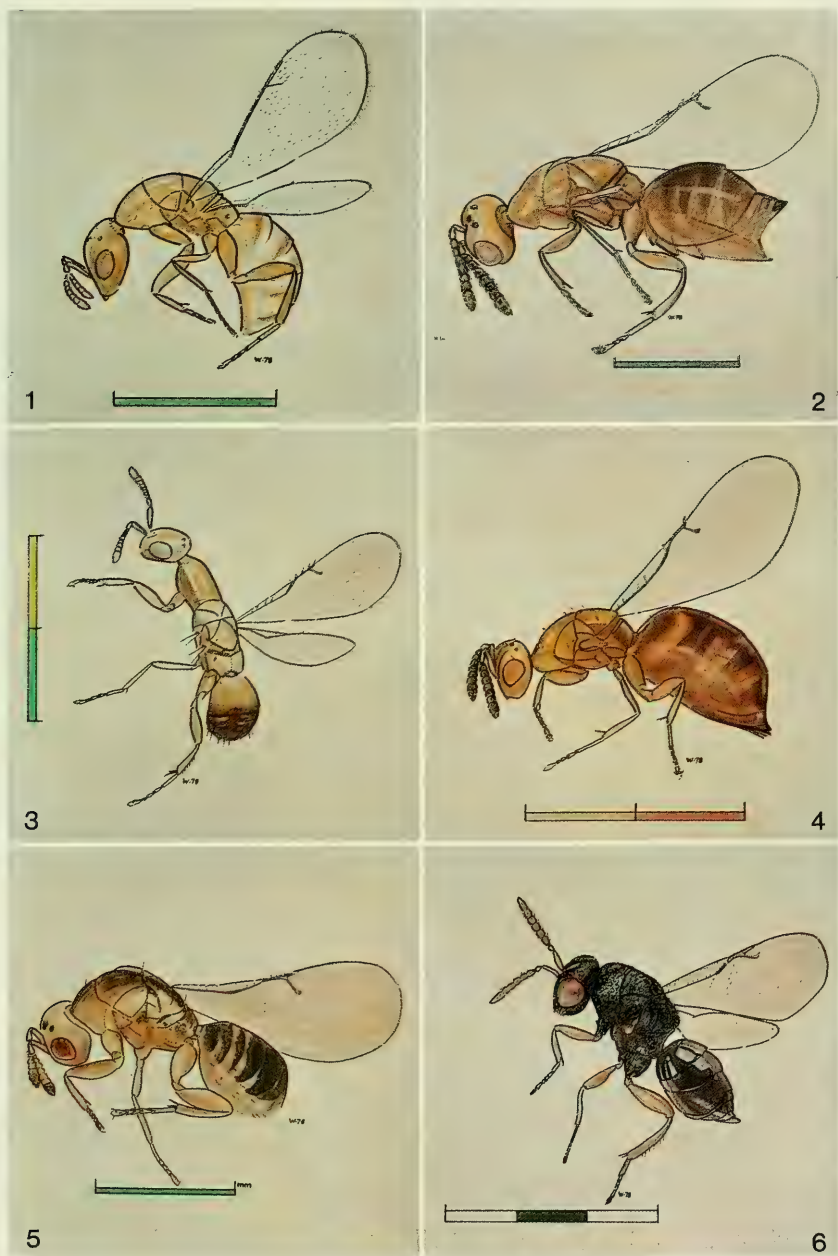


Fig. 1, *Philotrypesis parca* Wiebes, spec. nov., alate male; 2, *Sycotetra serricornis* Bouček, gen. et spec. nov., female; 3, *Camarothorax equicollis* Bouček, spec. nov., male; 4, *Camarothorax longimucro* Bouček, spec. nov., female; 5, *Camarothorax brevimucro* Bouček, spec. nov., male; 6, *Eurytoma ficusgallae* Bouček, spec. nov., female.

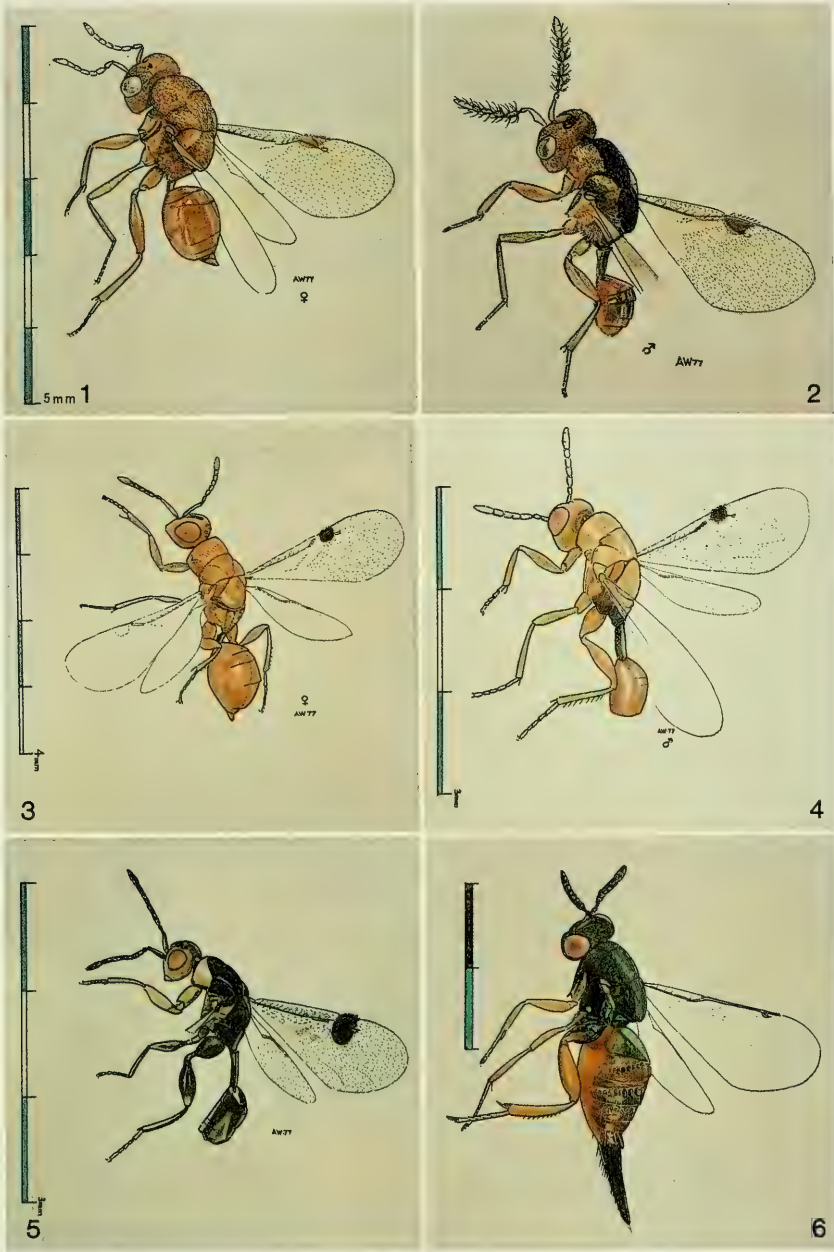


Fig. 1, *Syceurytoma ficus* Bouček, gen. et spec. nov., female; 2, do., male; 3, *Sycophila flaviclava* Bouček, spec. nov., female; 4, do., male; 5, *Sycophila kestraneura* (Masi), male; 6, *Ormyrus flavipes* Bouček, spec. nov., female.

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INHOUD

- J. KRIKKEN, C. VAN ACHTERBERG, P. H. VAN DOESBURG, R. DE JONG and K. W. R. ZWART. — Samuel Constant Snellen van Vollenhoven (1816—1880) and his entomological work, p. 235—268, figs. 1—3, one colour-plate.

SAMUEL CONSTANT SNELLEN VAN VOLLENHOVEN (1816-1880) AND HIS ENTOMOLOGICAL WORK

by

J. KRIKKEN, C. VAN ACHTERBERG, P. H. VAN DOESBURG,
R. DE JONG¹⁾ AND K. W. R. ZWART²⁾

With one plate and three text-figures

Hat sich nun ein Entomolog um unsre Wissenschaft nicht bloss in seinem engern Vaterlande und amtlichen Wirkungskreise, sondern auch nach vielen und bedeutenden Richtungen im Grossen und Ganzen so hochverdient gemacht wie Samuel Constant Snellen van Vollenhoven, so gebührt ihm ein Zeugniss der dankbaren Anerkennung.

C. A. Dohrn, 1881,
Stett. ent. Ztg. 42: 371

ABSTRACT

The significance of the entomological work of S. C. Snellen van Vollenhoven (1816-1880) is described by means of a concise biography, an annotated bibliography, and an annotated list of taxa he proposed. The bibliography includes 184 items. The list of taxa includes the names of 9 genera and 471 species proposed by Vollenhoven in the insect orders Dictyoptera, Orthoptera, Hemiptera, Coleoptera, Diptera, Hymenoptera and Lepidoptera.

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PREFACE

Now that we are compiling this account of the entomological activities of S. C. Snellen van Vollenhoven³⁾ a century has passed since he died: the first truly scientific entomologist in the Netherlands. Others had preceded him (e.g., Cramer, Stoll, Voet, Merian, Sepp), but their contributions to Dutch entomology were limited from a scientific point of view. Vollenhoven's achievements still keep us

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³⁾ The full family name Snellen van Vollenhoven is in this paper abbreviated Vollenhoven. Vollenhoven should not be confounded with the Dutch lepidopterist P. C. T. Snellen (1832-1911).

Leiden 10 April 1860.

Haar Edelgestinge Heer

Hiernevens doe ik ued tackamen
den afdruck van den Stukje, betreffende
het blindergevlacht *Papilio*, van welk
ik ook een kleine aanmerking betreffende
een soort voorkomt, die in uwe Verha-
meling in eenige exemplaren voorkomt
is. De blinder namelijk, die op uwen Cata-
logus den naam van *Ornithoptera Po-
seidon* draagt verschiet zeer veel van
de *Posidon*, zoo dat ik geneigd ben hem
voor een nieuwe soort te houden, ten-
zy drie of vier soorten als *Priamus*,
Posidon, *Richmondia* en *D'Urvillei*
niet dan locale rassen van een soort
zijn. Uw blinder is nog onbeschreven
en als zoodanig voor de liefhebbers
geld waard. Indien Ued. immer

Fig. 2. Handwriting of Snellen van Vollenhoven. Section of a letter written in 1860.



Fig. 3. Stone plate in wooden carved frame, commemorating Snellen van Vollenhoven's decease in 1880. It shows the symbols of two of his life-time's ambitions: a butterfly (top of frame) and a sketchbook and drawing-pen (bottom). Rijksmuseum van Natuurlijke Historie, Leiden.

busy, were it alone for the fact that, as museum curators, we are still dealing with the numerous insects he assembled and described. Therefore, we thought it a good idea to spend part of 1980, the centennial year of his death, on writing an account of Vollenhoven's entomological work. This account consists of a concise biography, a bibliography and a list of the genera and species he described. Specialists interested in Vollenhoven's work will find numerous verified details in the following pages; they will, however, not find solutions to any taxonomic problems they might have with respect to Vollenhoven's species. The list of taxonomic names given below is only intended as a preliminary survey of Vollenhoven's taxonomic activities. We hope that the present account will show our fellow entomologists, besides technical details, a man at the roots of Dutch entomology: to Vollenhoven life was nearly synonymous with the study of insects.

We are indebted to the Uyttenboogaart-Eliassen Foundation for financing the publication of plate 1.

BIOGRAPHY

Samuel Constant Snellen van Vollenhoven was born in Rotterdam on 18 October 1816. At the age of 18, after his secondary school education, he started to study law at the University of Leiden and graduated on 25 September 1839. Soon after his graduation he registered as a lawyer in The Hague, but there is no evidence that he ever actually practised. From his childhood Vollenhoven appeared to be more interested in the natural sciences, and, consequently, after his marriage with Jeanne Everdine Meijer, he moved to Leiden again with the explicit purpose of acquiring a more serious knowledge of animals and plants. He frequently visited the Rijksmuseum van Natuurlijke Historie and the Hortus Botanicus, and was delighted in conversing with the zoologists and botanists working in these institutions. After this second Leiden period Vollenhoven, disliking city life, took up his residence at the Gliphoeve, a country seat south of Haarlem. Here he spent, according to his own saying, the happiest years of his life. Vollenhoven now devoted himself almost entirely to insect studies. An early result of these studies is his publication on insects harmful or beneficial to horticulture (1843a).

Before Vollenhoven's time Dutch entomology had been largely the domain of a few amateurs and non-specialist biologists, and the scanty knowledge available on the Dutch insect fauna was totally unreliable. This changed drastically through the efforts of Vollenhoven: soon after its foundation in 1845 he joined the *Nederlandsche Entomologische Vereeniging* (Netherlands Entomological Society), and immediately impressed his fellow members with his scientific approach to entomology. They elected him President of the Society, an office he held till 1872, and again from 1878 till his decease in 1880. In 1858 he took the initiative to publish a Society journal, the *Tijdschrift voor Entomologie*, which was profusely illustrated, in the first place by Vollenhoven himself. Of the 277 plates published in the journal up till 1880 (23 vols.) no less than 155 had been prepared by Vollenhoven, who shared his artistic ambitions with contemporary entomologists, like J. O. Westwood, of Oxford, with whom he had a very intense correspondence.

The government recognized Vollenhoven's capacities by appointing him entomological curator of the Leiden museum in September 1854. What he found there seems to have been a mess, which was partly due to the protracted illness of his predecessor Dr. W. de Haan. The notorious C. A. Dohrn, of Stettin, on visiting Leiden shortly after Vollenhoven's appointment, noticed the curator's embarrassment over the state the collections were in. Vollenhoven, however, set to work energetically, and Dohrn clearly appreciated the improvement during a later visit, as he mentioned in Vollenhoven's obituary (1881; see quotation above). Vollenhoven's private collection was purchased by the museum and incorporated. His appointment necessitated Vollenhoven to move to Leiden once again. His curator's salary was not particularly high, and the resources of the museum were also very limited. Luckily, Vollenhoven was financially more or less independent, and he regularly spent private money to pursue his entomological endeavours. While continuing his work on the Dutch insect fauna, Vollenhoven's attention was also drawn to the exotic treasures kept in the Leiden museum. He described many novelties from the Dutch East Indies and other parts of the world, partly in well-illustrated monographs. From 1871 on Vollenhoven had rheumatic complaints, and

considered that resignation from his curatorial duties would improve his health. In 1873 he was succeeded by his able assistant C. Ritsema. Bureaucratic decisions barred Vollenhoven from further pursuing his survey of the East Indian insect fauna, and his attention now shifted to the Dutch Ichneumonoidea and Hemiptera, although his broad interest remained. He died on 22 March 1880, at the age of 63.

Indeed, Vollenhoven was the first truly scientific Dutch entomologist: reliable literature on the Dutch insect fauna was virtually non-existent until he compiled the first critical lists of Dutch Coleoptera (see bibliography, 1848), Diptera (1852c, 1853a), Hemiptera (1852d), Hymenoptera (1858a), Orthoptera (1859g), and their various sequels. He was keenly interested in economic entomology (cf. 1843a, 1852a). He published dependable popular surveys of Dutch arthropods (1859f, 1861g) and of insects in general (1870d). Vollenhoven described the metamorphoses and habits of Dutch Symphyta with numerous fine illustrations (1858g, etc.). His other important contributions to entomology include monographs of East Indian insect groups (1863k, 1865l, 1868f), a treatise on Dutch Hemiptera (1878j), and the *Pinacographia* (1875, etc.), being an atlas of Hymenoptera. All in all we counted 480 new names proposed by Vollenhoven, as follows:

	genera	species		genera	species
Dictyoptera	1	1	Coleoptera	2	97
Orthoptera	1	3	Hymenoptera	3	103
Heteroptera	1	155	Diptera	1	15
Homoptera	0	9	Lepidoptera	0	88

Vollenhoven's scientific efforts were rewarded by memberships of several foreign learned societies. In 1860 he became a member of the Koninklijke Academie van Wetenschappen (Royal Academy of Sciences). In April 1862 the University of Groningen bestowed on him the title of *Philosophiae naturalis doctor honoris causa*.

An extensive obituary was given by F. M. van der Wulp, 1880, *Tijdschr. Ent.* 24: LXXXIX-CVIII, in Dutch, with a portrait.

BIBLIOGRAPHY

All publications with separate title headings are included. Casual observations, not published under a separate heading and without any substance, can be found in meeting reports of the Netherlands Entomological Society as published in the *Tijdschrift voor Entomologie*; these have been omitted (we have a list of 35 additional items). Other minor contributions (e.g., to a dictionary) have also been omitted. Annotations are added where necessary, especially translations of titles in the Dutch language.

- 1843a. De schadelijke insecten in tuinen met de middelen tot derzelver verdelging, benevens eene opgave der voor tuinen nuttige insecten, p. 1—128, pls. 1—5. — Rotterdam. (Treatise of noxious and beneficial insects in gardens).
 1843b. Over de larve van de *Cimbex lucorum*. — *Tijdschr. Natgesch. Phys.* 10: 97—102, figs. 1—6. (Description of larva).

1844. Beschrijving eeniger larven van Tentredinidae. — Tijdschr. Natgesch. Phys. 11: 157—163. (Descriptions of larvae).
1848. Bijdrage tot de fauna van Nederland. Naamlijst van de schildvleugelige insecten, p v + (1) + 1—50. — Haarlem (His first checklist of the Dutch Coleoptera; cf. 1854c, 1870e).
- 1852a. De insecten welke den landbouwer schaden, p. 1—136, figs. 1—69. — Arnhem. (Noxious insects in agriculture; also published in 1856 by Kruseman at Haarlem).
- 1852b. Nederlandsche blad- en houtwespen. — Bouwst. Faun. Ned. (Herklots) 1: 104—112. (Dutch Symphyta).
- 1852c. Naamlijst van inlandsche Diptera. — Bouwst. Faun. Ned. (Herklots) 1: 138—151 (Checklist of the Dutch Diptera, with F. M. v. d. Wulp).
- 1852d. Nederlandsche Hemiptera. — Bouwst. Faun. Ned. (Herklots) 1: 169—186; (with H. W. de Graaf; Dutch Hemiptera).
1853. Naamlijst van inlandsche Diptera. — Bouwst. Faun. Ned. (Herklots) 1: 188—206. (2nd part of checklist, cf. 1852c; with F. M. v. d. Wulp).
- 1854a. Over het tweede deel van den “Schouburg der rupsen, wormen, maden en vliegende dieren daaruit voortkomende” van Steph. Blankaart. — Alg. Konst- en Letterbode 66: 159—160. (About a manuscript by S. Blankaart).
- 1854b. (Discussion about the genus *Canopus* (Hemiptera)). — Hand. Ned. Ent. Ver. 1: 63—64.
- 1854c. Naamlijst van de Nederlandsche schildvleugelige insecten. — Bouwst. Faun. Ned. (Herklots) 2: 1—70. (Checklist of the Dutch Coleoptera).
1855. Mierengasten. — Jaarb. Natura Artis Magistra: 140—148. (Popular short paper on ant guests in the province of Gelderland).
- 1856a. Nieuwe bijdragen voor de Fauna van Nederland. — Alg. Konst- en Letterbode 68: 178. (Short faunistical list of Coleoptera and Hemiptera of the Netherlands).
- 1856b. Naamlijst van inlandsche Diptera. — Bouwst. Faun. Ned. (Herklots) 2: 89—117. (With F. M. v. d. Wulp; checklist of Dutch Diptera).
- 1858a. Naamlijst van Nederlandsche vliesvleugelige insecten (Hymenoptera). — Bouwst. Faun. Ned. (Herklots) 2: 221—275. (Checklist of Dutch Hymenoptera).
- 1858b. Beschrijving der nieuwe soorten. — Bouwst. Faun. Ned. (Herklots) 2: 276—283. (Descriptions of new species of Hymenoptera).
- 1858c. Description de quelques espèces nouvelles de Coleoptères Lamellicornes. — Tijdschr. Ent. 1: 20—27, pl. 2.
- 1858d. Notes diptérologiques. — Tijdschr. Ent. 1: 88—93.
- 1858e. De rups van *Hepialus sylvinus*. — Tijdschr. Ent. 1: 98. (The caterpillar of *H. sylvinus*).
- 1858f. *Phyllodes Verhuellii*, nieuwe vlindersoort uit Java. — Tijdschr. Ent. 1: 159—168, pl. 8. (New moth from Java).
- 1858g. De inlandsche bladwespen in hare gedaanteverwisselingen en levenswijze beschreven (1). — Tijdschr. Ent. 1: 133—154, pls. 5—7. (First part of the series on Dutch Symphyta).
- 1858h. Id. (2). — Tijdschr. Ent. 1: 171—194, pls. 9—12. (Second part on Dutch Symphyta).
- 1859a. Id. (3). — Tijdschr. Ent. 2: 63—78, pls. 3—5. (Third part on Dutch Symphyta).
- 1859b. *Phyllodes Eyndhovii*, nieuwe vlindersoort uit Java. — Tijdschr. Ent. 2: 86—89, pl. 6. (New moth from Java).
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- 1859e. Over de verdedigingsmiddelen der bladwespen larven. — Jaarb. Natura Artis Magistra, p. 125—133. (Short paper on the defense-mechanisms of sawflies, mainly against parasites).
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- 1860b. Description d'une nouvelle espèce de lépidoptère du genre *Papilio*, suivie d'une énumération

- des espèces de ce genre, qui se trouvent au Musée royal des Pays-bas à Leide. — Tijdschr. Ent. 3: 67—89, pl. 6.
- 1860c. De inlandsche bladwespen in hare gedaanteverwisselingen en levenswijze beschreven. (5). — Tijdschr. Ent. 3: 99—119, 3 pls. (Fifth part on Dutch Symphyta).
- 1860d. Deux Lépidoptères nouveaux. — Tijdschr. Ent. 3: 125—127.
- 1860e. Beschrijving van eenige nieuwe soorten van bladwespen. — Tijdschr. Ent. 3: 128—130. (Descriptions of some new species of sawflies).
- 1860f. Over de larve van *Carabus auratus* L. — Tijdschr. Ent. 3: 166—167, pl. 12: A, B. (Note about larva of *C. auratus*).
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- 1860h. Iets over de Columbatscher-mug (*Simulium maculatum* Meig.). — Jaarb. Natura Artis Magistra: 128—135. (Short note about the midge *Simulium maculatum*).
- 1860i. Etwas über die Columbatscher Mücke (*Simulium maculatum* Meig.). — Stett. ent. Ztg 21: 306—319. (Introduction and translation of 1860h. by C. A. Dohrn).
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- 1861d. Beschrijving van eenige nieuwe soorten van Lucanidae. — Tijdschr. Ent. 4: 101—115, pls. 5—7. (Description of new Lucanidae).
- 1861e. Description de quelques espèces nouvelles de Lépidoptères. — Tijdschr. Ent. 4: 157—163, pls. 8—10.
- 1861f. Bij de afbeelding der larve en pop van *Rhyssa persuasoria*. — Tijdschr. Ent. 4: 176—177, pl. 12. (Note on figures of *Rhyssa persuasoria*).
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- 1866b. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (12). — Tijdschr. Ent. 9: 189—208, pls. 7—9. (Twelfth part of his series on Dutch Symphyta).
- 1866c. Description de deux nouvelles espèces de Lépidoptères. — Tijdschr. Ent. 9: 209—210, pl. 10.
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255—260, pl. 11, figs. a—e. (Description of six new species of Heteroptera).

- 1869d. Schetsen ten gebruike bij de studie der Hymenoptera. 2nd part. 3 pls. (Braconidae; cf. 1868e).
- 1869e. Recherches sur la Faune de Madagascar et de ses dépendances, d'après des découvertes de François P. L. Pollen et D. C. van Dam, Insectes, 5(1): 1—14, 2 pls. — Leiden. (with E. de Selys Longchamps; list and descriptions of some new species collected in Madagascar and surrounding islands).
- 1870a. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (15). — Tijdschr. Ent. 13: 55—74, pls. 1—4. (Fifteenth part on Dutch Symphyta).
- 1870b. Bijschrift bij Plaat 6. — Tijdschr. Ent. 13: 158, pl. 6. (Text of plate 6).
- 1870c. De inlandsche Hemipteren beschreven en meerendeels ook afgebeeld. Derde stuk met drie platen. — Tijdschr. Ent. 13: 263—302, pls. 10—12. (Third part of paper on Dutch Hemiptera).
- 1870d. Gedaantewisseling en levenswijze der Insecten. p. 1—457, figs. 1—251, 4 pls. — Haarlem. (The insects, their biology; a general survey; reprinted in 1876 (Amsterdam)).
- 1870e. Laatste lijst van Nederlandsche schildvleugelige insecten (Insecta Coleoptera), p. i—iv + (1) + 1—146. (Checklist of the Dutch Coleoptera).
- 1870f. Jean Théodore Lacordaire — Ned. Spectator, p. 321—322. (Obituary of J. T. Lacordaire).
- 1870g. Verslag van de vier-en-twintigste algemene vergadering der Nederlandsche Entomologische Vereeniging, gehouden te Zwolle, den 31sten Julij 1869. — Tijdschr. Ent. 13: 17—20. (Record of *Polysphincta carbonator* Grav. as ectoparasite of *Miranda cucurbitina* and notes on other parasites of spiders).
- 1871a. (Comment on Darwin's theory of evolution). — Tijdschr. Ent. 14: 28—29.
- 1871b. Quelques espèces nouvelles de Curculionites et de Longicornes. — Tijdschr. Ent. 14: 101—112, pls. 4—5.
- 1871c. Les Batocérides du Musée de Leide. — Tijdschr. Ent. 14: 211—220, pl. 9.
- 1871d. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (16). — Tijdschr. Ent. 14: 237—254, pls. 10—12. (Sixteenth part on the Dutch Symphyta).
- 1871e. Schetsen ten gebruike bij de studie der Hymenoptera. 3rd part, 4 pls. Pteromalidae. (cf. 1868e).
- 1871f. [Description of *Eupoecila balteata*, in Mohnike, O., Uebersicht der Cetoniden der Sunda-Inseln und Molukken]. — Arch. Naturg. 37: 277, pl. 6 fig. 3. (Letter of Vollenhoven quoted verbatim, his figure published).
- 1872a. Bladvulling. — Tijdschr. Ent. 15: 111—112. (Notes on some Tenthredinidae in the Ritsema Collection).
- 1872b. Opmerkingen omtrent een miskenden Sumatraanschen kever. — Tijdschr. Ent. 15: 125—128. (Notes on *Rhomborrhina*, Cetoniidae).
- 1872c. Beschreibung einer neuen *Paussus*-Art aus Ost-Indien, *Paussus Ludekingii*. — Stett. ent. Ztg. 33: 82.
- 1872d. Over de ziekte van de wijnstok in Frankrijk en de *Phylloxera vastatrix*. — Alb. Nat. Haarlem, p. 33—46. (Paper on the pest by *Phylloxera vastatrix* in France).
- 1873a. Aderen in de ondervleugels der Hemiptera en andere mededelingen. In: Verslag van de zesde wintervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Leiden, den 28 December 1872. — Tijdschr. Ent. 16: LIV—LVIII. (On the veins of the hind wings of Hemiptera).
- 1873b. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (17). — Tijdschr. Ent. 16: 1—15, pls. 1—3. (Seventeenth part on the Dutch Symphyta).
- 1873c. Trois espèces nouvelles du genre *Rhyssa*. — Tijdschr. Ent. 16: 67—70, pl. 4.
- 1873d. De inlandsche Hemipteren beschreven en meerendeels ook afgebeeld. Vierde stuk met drie platen. — Tijdschr. Ent. 16: 75—122, pls. 5—7. (Fourth part of the paper on Dutch Hemiptera).
- 1873e. Nieuwe naamlijst van Nederlandsche vliesvleugelige insecten (Hymenoptera), tweede stuk. — Tijdschr. Ent. 16: 147—208. (Second part of a checklist of Dutch Hymenoptera).
- 1873f. Beschrijving der nieuwe soorten. Bijlage tot de lijst van inlandsche Hymenoptera. — Tijdschr. Ent. 16: 209—220, pl. 9. (Descriptions of 13 new species of Ichneumonoidea).
- 1873g. Description d'un *Bombus* nouveau de l'île de Sumatra. — Tijdschr. Ent. 16: 229—230, pl. 10.

- 1873h. Description de trois espèces nouvelles de Lépidoptères des Indes Orientales. — Tijdschr. Ent. 16: 244—247, pls. 11—12.
- 1873i. Schetsen ten gebruike bij de studie der Hymenoptera. 4th part, 4 pls. — 's-Gravenhage. (Proctotrupoidea).
- 1873j. Vijf entomologische wandelingen, p. 1—162, ill. — Haarlem. (Five "entomological walks" are described).
- 1873k. Een snuitkever en een sluipwespje. — Jaarb. Natura Artis Magistra: 155—168. (Popular paper about some observations by Stollwerk concerning the hymenopterous parasite of *Attelabus curculionoides*).
- 1873l. Een indringster en hare gevechten. — Jaarb. Natura Artis Magistra: 173—180. (Popular paper on the biology of the ant genus *Solenopsis*).
- 1874a. Verslag van de acht-en-twintigste zomervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Breda den 7 Junij 1873. — Tijdschr. Ent. 17: xiii—xv. (Notes on Dryinidae and *Tenthredo agilis* Klug).
- 1874b. Over de groep der Dryiniden in de familie der Proctotrupiden, met beschrijving eener nieuwe soort — Versl. Meded. K. Akad. Wet., Amst. (2) 8: 150—162, figs. 1—6. (Notes on the Dryinidae, with description of *Dryinus spectrum* Snellen van Vollenhoven).
- 1874c. Verslag van de zevende wintervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Leiden den 6 December 1873. — Tijdschr. Ent. 17: LXV—LXVI. (List of Hymenoptera new to the Dutch fauna, i.a. *Dryinus spectrum* n.sp.).
- 1875a. Verslag van de negen-en-twintigste zomervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Arnhem den 29 Augustus 1874. — Tijdschr. Ent. 18: xx—xxii+xxxi—xxxii. (Notes on Dutch Lepidoptera, Hemiptera and Hymenoptera).
- 1875b. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (18). — Tijdschr. Ent. 18: 33—49, pl. 3—5. (Eighteenth part on the Dutch Symphyta).
- 1875c. Systematische lijst der in dit Tijdschrift beschreven gedaantewisselingen van bladwespen. — Tijdschr. Ent. 18: 50—52. (List of Dutch Symphyta of which metamorphosis was described in this journal).
- 1875d. De inlandsche Hemipteren, beschreven en meerendeels ook afgebeeld. Vijfde stuk met drie platen. — Tijdschr. Ent. 18: 150—185, pls. 8—10. (Fifth part on Dutch Hemiptera).
- 1875e. Pinacographia. — Illustrations of more than 1000 species of North-West-European Ichneumonidae sensu Linnaeano, p. 1—8, pls. 1—5. (Series of papers on about 400 species of Ichneumonidae, Braconidae, Chalcidoidea, and Proctotrupoidea, all illustrated and shortly described. Incomplete when Vollenhoven died. N.B. Preface (p. I—IX), index and p. 65—68 are by G. A. Six (1880)).
- 1875f. Id. — p. 9—16, pls. 6—10.
- 1875g. De Colorado-kever. — Alb. Nat., Haarlem: 97—104. (Popular paper on *Leptinotarsa decemlineata* Say).
- 1875h. De wurm in 't hout (*Anobium pertinax*). — Alb. Nat., Haarlem: 187—189. (Popular paper on some *Anobium* spp. and their parasite).
- 1876a. Verslag van de dertigste zomervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Amsterdam op Zaterdag 24 Julij 1875. — Tijdschr. Ent. 19: XL—XLII. (Notes on some Lepidoptera and Hymenoptera).
- 1876b. Verslag van de negende wintervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Leiden op Zaterdag 18 december 1875 des avonds ten 7 ure. — Tijdschr. Ent. 19: CIX—CXIII. (Comparison of the fauna of Heteroptera of the Netherlands and Great Britain).
- 1876c. De inlandsche Hemipteren, beschreven en meerendeels ook afgebeeld. Zesde stuk met 3 platen. — Tijdschr. Ent. 19: 65—132, pls. 3—5. (Sixth part on Dutch Hemiptera).
- 1876d. Iets over *Otiorhynchus sulcatus* L. — Tijdschr. Ent. 19: 210. (Record from the Netherlands).
- 1876e. Bijvoegsel tot de nieuwe naamlijst van Nederlandsche vliesvleugelige insecten (Hymenoptera). — Tijdschr. Ent. 19: 211—257. (Additions to the checklist of Dutch Hymenoptera).
- 1876f. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (19). — Tijdschr. Ent. 19: 258—277, pls. 10—12. (Nineteenth part of series on Dutch Symphyta).
- 1876g. Pinacographia, p. 17—24, pls. 11—15. (Third part of this series on Hymenoptera).
- 1876h. Id., p. 25—32, pls. 16—20 (Fourth part of this series).
- 1877a. Verslag van de een-en-dertigste zomervergadering der Nederlandsche Entomologische Ver-

- eeniging, gehouden te Middelburg. — Tijdschr. Ent. 20: xiii—xv. (Some notes on galls of *Andricus ramuli* L. and on the caterpillar of *Meterocampa margaritaria* L.).
- 1877b. Verslag van de tiende wintervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Leiden op Zaterdag 23 December 1876. — Tijdschr. Ent. 20: lxxiv—lxxvii. (Lists of galls, and of scarce Dutch Heteroptera are given; *Coleophoraonosmella* Brahns and a *Coccus* species).
- 1877c. Bijdrage tot de kennis der gedaantewisseling van Diptera. — Tijdschr. Ent. 20: 57—63, pl. 4 figs. 1—5. (Notes on the biology of *Machaerium maritimum* Hal.).
- 1877d. *Tryphon praerogator* Grav. — Tijdschr. Ent. 20: 64. (Short note on its identity).
- 1877e. De inlandsche Hemipteren, beschreven en meerendeels ook afgebeeld. Zevende stuk met vier platen. — Tijdschr. Ent. 20: 90—167, pls. 7—10. (Seventh part of the series on Dutch Hemiptera).
- 1877f. Pinacographia, p. 33—39, pls. 21—25. (Fifth part of the series).
- 1877g. Determinatie der platen in het werk van Joannes Goedaert. — Alb. Nat., Haarlem: 307—318. (On the identification of insects figured by Joannes Goedaert).
- 1878a. Verslag van de twee-en-dertigste zomervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Utrecht op Zaterdag 30 Junij 1877. — Tijdschr. Ent. 21: xvii—xix. (On an *Ephemera* species, *Cheimatobia* and some spp. from the Holmgren Collection).
- 1878b. Verslag van de elfde wintervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Leiden op Zaterdag 22 December 1877. — Tijdschr. Ent. 21: LXXIV—LXXVII. (On Indonesian Ichneumonidae and the checklist of Dutch Hymenoptera).
- 1878c. Un *Ephialtes* de Java, *Ephialtes Melanomerus* de Haan. — Tijdschr. Ent. 21: 48.
- 1878d. De inlandsche Hemipteren, beschreven en meerendeels ook afgebeeld. Achtste stuk met twee platen. — Tijdschr. Ent. 21: 49—80, pls. 3—4. (Eighth part on the Dutch Hemiptera).
- 1878e. Oproeping. — Tijdschr. Ent. 21: 126—128. (Appeal concerning Orthoptera).
- 1878f. Espèces nouvelles ou peu connues d'Hymenoptères térébrants. — Tijdschr. Ent. 21: 153—177, pls. 9—11.
- 1878g. Pinacographia, p. 41—48, pls. 26—30. (Sixth part of the series).
- 1878h. Id. p. 49—56, pls. 31—35. (Seventh part of the series).
- 1878i. Hemiptera Heteroptera Neerlandica. De inlandsche ware Hemipteren. (Land- en waterwantsen) beschreven en meerendeels ook afgebeeld, p. 1—368, pls. 1—22. 's-Gravenhage. (Treatise on the Dutch Heteroptera).
- 1879a. Verslag van de drie-en-dertigste zomervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Nijmegen op Zaterdag 29 Junij 1878. — Tijdschr. Ent. 22: ix—xiii+xxvi. (Notes on *Typhlocyba* and other faunistic data; description of *Proctotrupes sixianus*).
- 1879b. Verslag van de twaalfde wintervergadering der Nederlandsche Entomologische Vereeniging, gehouden te Leiden op Zondag 22 December 1878. — Tijdschr. Ent. 22: xc. (On *Ephippigera vitium* Serv. and *Cratomus megacephalus* F.).
- 1879c. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (20). — Tijdschr. Ent. 22: 1—20, pls. 1—4. (Twentieth part of the series on Dutch Symphyta).
- 1879d. Bijvoegsel tot de lijst der inlandsche Hemiptera Heteroptera. — Tijdschr. Ent. 22: 227—231, pl. 12, figs. C—F. (Additions to the checklist of Dutch Heteroptera).
- 1879e. Einige neue Arten von Pimplarien aus Ost-Indien. — Stett. ent. Ztg. 40: 133—150.
- 1879f. Pinacographia, p. 57—64, pls. 36—40. (Eighth part of the series).
- 1880a. Verslag van de vier-en-dertigste zomervergadering der Nederlandsche Entomologische Vereeniging. — Tijdschr. Ent. 23: XIV—XVI. (Short enumeration of some interesting species of Hymenoptera new to the Dutch fauna and a note on *Typhlocyba*).
- 1880b. De inlandsche bladwespen in hare gedaantewisseling en levenswijze beschreven (21). — Tijdschr. Ent. 23: 4—16, pls. 1—3. (21st part on the Dutch Symphyta).
- 1880c. Pinacographia, p. 65—68, pls. 41—45. (Ninth part of the series, text by G. A. Six).
- 1880d. Levensschets van Mr. Pierre Lyonet. — Alb. Nat., Haarlem: 1—14, 1 portrait. (Sketch of the life of P. Lyonet).
- 1880e. Lyonet's Microscoop. — Alb. Nat., Haarlem: 62. (Short note about the fate of Lyonet's microscope).

GENUS-GROUP AND SPECIES-GROUP NAMES FIRST PUBLISHED BY SNELLEN VAN
VOLLENHOVEN

To our knowledge, Vollenhoven published nine new genus-group names and 471 new species-group names. The following list gives all the names we have found, in their original combination, alphabetically arranged within the families in which they are currently placed. Each species-group name is followed by a reference to the bibliography and many are followed by the name of the genus in which the species is currently placed. Furthermore type-localities are cited, usually in the original spelling. Frequently a country name is added between brackets.

The status of type-material is given as follows. Holotype: Vollenhoven undoubtedly had only one specimen at hand; syntypes: Vollenhoven undoubtedly had more specimens at hand or did not specify the number. If not indicated otherwise, the specimens are present in the Leiden museum. The number of syntypes is the number of specimens found in the collections, and does not indicate the number of types originally at hand. So "1 syntype" means that one specimen has been found; this might in fact be the only specimen Vollenhoven had.

In the Hymenopterous family Ichneumonidae most of the types of Dutch species were found in the collection of the Dept. of Entomology in Wageningen. For this family the presence of type-material in Leiden en Wageningen is mentioned separately.

Vollenhoven did not label his types as such. In many cases he even did not add a name to the pin. This will certainly have caused the loss of various types and makes it difficult to recognise them.

A few specimens bear lectotype labels, but we are not always sure whether the designations were actually published. The reverse may also be true. Where the designation of a lectotype is known to have been published, this is indicated. None of the statements in the present list should be interpreted as a nomenclatorial action taken by the compilers, i.e. neither the statements concerning lectotypes, nor those concerning recombinations, synonymies, etc. We have not included information on current species-level synonymies except those proposed by Vollenhoven himself. The reason is that these synonymies are only rarely based on a study of the type-specimens.

The lists for the various orders have been compiled by the authors, viz., J. Kriken (Coleoptera), P. H. van Doesburg (Dictyoptera, Orthoptera, Hemiptera), C. van Achterberg (Hymenoptera), K. W. R. Zwart (Hymenoptera: Ichneumonidae in the Wageningen collection) and R. de Jong (Lepidoptera). P. J. van Helsdingen supplied information concerning Diptera. All are curating the collections of these groups in the Leiden museum or the collection of the Dept. of Entomology in Wageningen. Any enquiries should be addressed to the curator of the group concerned.

ORDER DICTYOPTERA
Family Archiblattidae

Archiblatta, 1862e: 106, type-sp. *A. hoevenii* Vollenhoven, 1862 (monotypy).

Archiblatta hoevenii, 1862e: 106, pl. 6 figs. 1—2, Padangse Bovenlanden, or Agam (Sumatra), holotype, ♀.

ORDER ORTHOPTERA

Family Tettigoniidae

Macrolyristes, 1865g: 106, type-sp. *M. imperator* Vollenhoven, 1865 (monotypy).

Macrolyristes imperator, 1865g: 108, pl. 7 figs. 1—2, pl. 8, figs. A, B, C, Java, Borneo, 1 ♂ syntype, Pengorag (Borneo).

Family Acrididae

Oedipoda virgula, 1869e: 3, 11, pl. 2 fig. 2, Madagascar, 2 ♂ syntypes.

Family Tetrigidae

Tetrix limosina, 1865d: 65, pl. 1 figs. 6—8 (to *Ophiotettix*), Isl. Gebeh, 2 ♀ syntypes.

ORDER HEMIPTERA

Suborder HETEROPTERA

Family Berytidae

Berytus driebergensis, 1869a: 64, pl. 1 fig. 9 (to *Berytinus*), De Bildt, Sterkenburg nr. Driebergen (Netherlands), 2 ♂ syntypes.

Family Coreidae

Choerommatus niger, 1869e: 5, 14, pl. 1 fig. 8, Mayotte (Comores), holotype, ♀.

Coreus difficilis, 1869a: 56, pl. 1 fig. 5 (to *Ceraleptus*), Den Haag, (Netherlands), holotype, ♂.

Family Cydnidae

Acatalectus flavomarginatus, 1868d: 177 (to *Adrisa*), Nova Caledonia, 4 syntypes.

Acatalectus luteomarginatus, 1868d: 177 (to *Adrisa*), Timor, Flores, 3 syntypes; 1868f: 19, pl. 2 fig. 9.

Aethus pallidicornis, 1868d: 177 (to *Geotomus*), Bezoeki (Java), Ceram, 8 syntypes; 1868f: 17, pl. 2 fig. 8.

Cyrtomenus insignis, 1868d: 177 (to *Scoparipes*), Java, Sumatra, Borneo, 6 syntypes; 1868f: 16, pl. 2 fig. 7.

Family Microphysidae

Microphysa sanguinea, De Graaf & Snellen van Vollenhoven, 1852d: 175 (to *Loricuta*), Leiden, (Netherlands), 1 ♀ syntype.

Family Miridae

Lopus subpatellatus, 1875d: 172, pl. 9, figs. 2, 2a (to *Conostethus*), Netherlands, Texel, Velp, (Netherlands), 2 syntypes.

Lygus aurantiacus, 1876c: 103, (to *Phylus*), Holland, holotype, ♂.

Family Pentatomidae

Alcimus collaris, 1868d: 182 (to *Alcimocoris*), Timor, 1 ♂ syntype.

Alcimus venustus, 1868d: 182 (to *Alcimocoris*), Gorontalo, (Sulawesi), 1 ♀ syntype.

Asopus bernsteini, 1868f: 14, pl. 2 fig. 6 (to *Amyotea*), Nova Guinea, 1 ♀ syntype.

Asopus carnifex, 1868f: 12, pl. 2 fig. 3 (to *Amyotea*), Ternate, 1 ♂, 1 ♀ syntypes.

Asopus distigma, 1868f: 13, pl. 2 fig. 4 (to *Amyotea*), Amboina, Ternate, 3 ♀ syntypes.

- Asopus semiviolaceus*, 1868f: 13, pl. 2 fig. 5 (to *Amyotea*), Halmaheira, holotype, ♀.
Aspidestrophus lineola, 1863k: 44, pl. 3 figs. 10, 10a, Borneo, 2 ♂, 1 ♀ syntypes.
Spongopus muelleri, 1868f: 39, pl. 4 fig. 5 (to *Coridius*), Java, 1 ♂, 3 ♀ syntypes.
Canthecona acuta, 1868f: 9, pl. 2 fig. 1 (to *Cantheconidea*), Timor, Halmaheira, 1 ♂, 3 ♀ syntypes.
Canthecona apicalis, 1868f: 6, pl. 1 figs. 3, 3a (to *Platynopus*), Ternate, Halmaheira, Batjan, Morotai, Gebeh (Moluccas), 1 ♂, 4 ♀, 1 ?, syntypes.
Canthecona biguttata, 1868f: 8, pl. 1 fig. 6 (to *Platynopus*), Aru, holotype, ♀.
Canthecona decorata, 1868f: 9, pl. 2 fig. 2 (to *Montrouzierellus*), Halmaheira, holotype, ♀.
Canthecona mitis, 1868f: 7, pl. 1 fig. 5 (to *Cantheconidea*), Amboina, Timor, 3 ♀ syntypes.
Canthecona plebeja, 1868f: 7, pl. 1 fig. 4 (to *Cantheconidea*), Ternate, holotype, ♂.
Canthecona rufescens, 1868f: 6, pl. 1 fig. 2 (to *Cantheconidea*), Java, Borneo, 3 ♀ syntypes.
Canthecona variabilis, 1868f: 8, pl. 1 figs. 7—8 (to *Cantheconidea*) Timor, 3 ♂, 7 ♀ syntypes.
Cazira coccinelloides, 1868f: 4 (to *Blachia*?), Hindostan, 1 ♂ syntype.
Chlaenocoris pusillus, 1863k: 45, pl. 3 figs. 11, 11a (to *Sepontia*), Java, holotype, ♀.
Chlorocoris roseus, 1868d: 178, patria ignota, 1 ♀ syntype.
Coenus punctatissimus, 1868d: 183, Wisconsin (U.S.A.), 1 ♂ syntype.
Cuspicona antica, 1868d: 188, Hindostan, 1 ♀ syntype.
Cuspicona basimaculata, 1868d: 188 (to *Vitellus*), Waigeou, 2 ♂, 2 ♀ syntypes.
Cuspicona eltio, 1868d: 188 (to *Vitellus*), Amboina, 1 ♂, 1 ♀ syntypes.
Cyclopelta trimaculata, 1868f: 37, pl. 4 fig. 4, Malacca, Borneo, 2 ♀ syntypes.
Dalcantha amyoti, 1866d: 219, pl. 11 fig. 7 (to *Carpona*), India Orientalis, ? Sumatra, 2 ♀ syntypes.
Dalcantha sanctifargavii, 1866d: 218, pl. 11 fig. 6 (to *Pycanum*), Sylhet (India), 1 ♂ syntype.
Dalcantha servillei, 1866d: 220, pl. 11 fig. 9 (to *Pseudopycanum*), Malacca, 1 ♂, 1 nymph, syntypes.
Dalcantha stalii, 1866d: 220, pl. 11 fig. 8, Sylhet (India), 4 ♂ syntypes.
Dalcantha westwoodii, 1866d: 217, pl. 11 fig. 5 (to *Pseudopycanum*), Sumatra, 1 ♀ syntype.
Dalpada aenea, 1868d: 179, Timor, 1 ♂ syntype.
Dalpada crux, 1868d: 179, Timor, 2 ♂, 4 ♀ syntypes.
Dalpada triguttata, 1868d: 179, Java, Borneo, 2 ♂, 2 ♀, syntypes.
Diceraeus euschistoides, 1868d: 180, Wisconsin (U.S.A.), 1 ♂ syntype.
Diceraeus sellula, 1868d: 179, Java, 1 ♀ syntype.
Dryptocephala divergens, 1868d: 178, Rio de Janeiro (Brasil), 1 ♀ syntype.
Euthemes minor, 1868f: 29, Java, Sumatra, 1 ♂, 6 ♀ syntypes.
Eysarcoris coecus, 1868d: 183, Timor, 1 ♂, 3 ♀ syntypes.
Eysarcoris geminatus, 1868d: 182, Java, 1 ♂ syntype.
Eysarcoris lineola, 1868d: 183, Timor, Borneo, syntypes. Not seen.
Eysarcoris marmoratus, 1868d: 183 (to *Menida*), Timor, 1 ♀, syntype.
Eysarcoris obscurus, 1868d: 182, Java, Sumatra, 2 ♂ syntypes.
Eysarcoris rufoscutellatus, 1868d: 183 (to *Menida*), Timor, 1 ♀, syntype.
Gynenica dalpadoides, 1868d: 178, Moluccas, 1 ♀ syntype.
Hoplistodera decora, 1868d: 181, Manilla, 3 ♀ syntypes.
Hoplistodera gibba, 1868d: 181 (to *Paracritheus*), Gorontalo, (Sulawesi), 1 ♂ syntype.
Hoplistodera schwaneri, 1868d: 182, Borneo, 1 ♂ syntype.
Loxa minor, 1868d: 179 (to *Fecelia*), Portorico, 1 ♂ syntype.
Lynamorpha perelegans, 1868f: 35, Nouvelle Hollande (Australia), 1 ♂, type ?, = *L. rosea* Hope, co-type.
Megarhynchus fuscus, 1868f: 43, 44 (to *Megarrhamphus*), Ningpo (Japan), 2 ♂ syntypes.
Megarhynchus intermedius, 1868f: 43, 44 (to *Megarrhamphus*), Ningpo, 1 ♂, 3 ♀ syntypes.
Megymenum anacanthum, 1868f: 46, pl. 4 fig. 9 (to *Anoplocephala*), Sumatra, holotype ♀ lost.
Megymenum parallelum, 1868f: 48, pl. 4 figs. 10, 10a (to *Pseudaradus*), Java, Sumatra, 1 ♀, syntype (Java), 2 syntypes lost.
Megymenum quadratum, 1868f: 46, pl. 4 fig. 7 (to *Anoplocephala*), Morotai, 2 syntypes lost.
Megymenum semivestitum, 1868f: 46, pl. 4 fig. 6 (to *Anoplocephala*), Amboina, Ceram, 1 ♂, 4 ♀ syntypes, 2 syntypes lost.
Mormidea hoplites, 1868d: 181 (to *Cuspicona*), Timor, 1 ♂ syntype.
Mormidea haematica, 1868d: 181 (to *Carbula*), Java, 1 ♀ syntype.
Mormidea trisignata, 1868d: 181 (to *Carbula*), Java, Sumatra, 1 ♂, 1 ♀ syntypes (both from Java).
Mormidea vidua, 1868d: 180 (to *Padaeus*), Guatemala, 1 ♂, type.

- Mucanum patibulum*, 1868f: 22, pl. 3 figs. 1, 1a, Sumatra, 2 ♂, 1 ♀, syntypes.
Oncomerus bernsteinii, 1868f: 30, pl. 4 fig. 1, Halmaheira, Morotai, 2 ♂, 1 ♀, syntypes.
Oncomerus flavicornis Guér. var. *chrysoptera*, 1868f: 30, pl. 4, fig. 2, Waigeou, 2 syntypes.
Oplomus flavoguttatus, 1863e: 123, Suriname, 2 ♂ syntypes.
Oplomus haematicus, 1863e: 122, Suriname, 3 ♀ syntypes.
Oplomus rubropictus, 1863e: 121, México, 2 ♀ syntypes.
Pentatoma arlechino, 1868d: 184, Sumatra, 1 ♂, 2 ♀ syntypes.
Pentatoma chloris, 1868d: 184, (to *Hyrmine*), Java, Sumatra, 2 ♂, 1 ♀, syntypes.
Pentatoma hilaris, 1868d: 184 (to *Antestia*), Java, 1 ♀ syntype.
Pentatoma ignobilis, 1868d: 184 (to *Antestia*), Tondano (Sulawesi), 1 ♂, 1 ♀ syntypes.
Pentatoma nurus, 1868d: 185 (to *Antestia*), Java, 1 ♀ syntype.
Pentatoma pallidiventris, 1868d: 183 (to *Tolumnea*), Java, Sumatra, Biliton, Borneo, 5 ♂, 3 ♀ syntypes.
Pentatoma plebeja, 1868d: 184 (to *Antestia*), Java ?, 1 ♂ syntype.
Pentatoma scurra, 1868d: 185 (to *Antestia*), Java, Sumatra, 2 ♀ syntypes.
Placosternum bison, 1868d: 188, Morotai (Indonesia); 1868f: 40, 1 ♀ type.
Podops breviscutum, 1869e: 5, 13 (to *Thoria*), Nossi-Bé (Malagasy), holotype, ♂.
Podops serratus, 1863k: 42, pl. 3 figs. 9, 9a (to *Scotinophara*), Borneo, Celebes, 5 ♂, 4 ♀ syntypes.
Podops tarsalis, 1863k: 42, pl. 3 fig. 8 (to *Scotinophara*), Java, Borneo, 1 ♂, 2 ♀ syntypes.
Podops vermiculatus, 1863k: 41, pl. 3 figs. 7, 7a (to *Scotinophara*), Sumatra, Borneo, 4 ♂, 5 ♀ syntypes.
Proxys rhododactylus, 1868d: 180, Caracas. Not seen.
Pygoplatys minax, 1868f: 23, pl. 3 fig. 3, Borneo, holotype, ♀.
Pygoplatys roseus, 1868f: 24, Malacca, holotype, ♀.
Pygoplatys subrugosus, 1868f: 23, pl. 3 fig. 2, Ambon, Buru, 2 ♂, 4 ♀ syntypes.
Rhaphigaster celebensis, 1868d: 187 (to *Acrosternum*), Tondano (Sulawesi), 3 ♂, 3 ♀ syntypes.
Rhaphigaster ludekingii, 1868d: 187 (to *Glaucias*), Java, Sumatra, Borneo, 3 ♂, 2 ♀ syntypes.
Rhaphigaster megalops, 1868d: 187 (to *Elemana*), Nova Guinea, 1 ♀ syntype.
Rhaphigaster melanosticticus, 1868d: 187 (to *Glaucias*), Java, 1 ♀ syntype.
Rhaphigaster nitens, 1868d: 187 (to *Menida*), Sumatra, 1 ♀ syntype.
Spudaeus modestus, 1868d: 178 (to *Ectenus*), Waigeou, 2 ♀, 1 ?, syntypes.
Strachia coelestis, 1868d: 186 (to *Stenozygum*), Nova Hollandia (Australia), 1 ♀ syntype.
Strachia instabilis, 1868d: 186 (to *Antestia*), Timor, Isl. Wetar, 3 ♂, 5 ♀, syntypes.
Strachia quincunx, 1868d: 186 (to *Antestia*), Waigeoe, 2 ♀ syntypes.
Strachia rubescens, 1868d: 186 (to *Stenozygum*), Celebes, 2 ♀ syntypes.
Strachia sanguineguttata, 1868d: 185 (to *Stenozygum*), Batjan, Salawatti, 1 ♂, 1 ♀ syntypes.
Strachia varians, 1868d: 185 (to *Stenozygum*), Timor, 4 ♂, 4 ♀ syntypes.
Tarisa dromedarius, 1863k: 57, pl. 4 figs. 11, 11a (to *Brachycerocoris*), Tondano (Sulawesi), 1 ♂, 3 ♀ syntypes.
Tessaratoma javanica Thunberg var. *stictica*, 1868f: 26 (var. nov.), Java, holotype, ♀.
Tessaratoma javanica Thunberg var. *timorensis*, 1868f: 26, pl. 3 fig. 5 (not 4!) (var. nov.), Timor, Adonara, 2 ♂, 3 ♀ syntypes.
Vulsirea hemichloris, 1868d: 187 (to *Hyrmine*), Salawatti, 2 ♀ syntypes.
Vulsirea tau, 1868d: 186, Rio de Janeiro, 1 ♂, type.

Family Plataspididae

- Brachyplatys crux*, 1863k: 54, pl. 4 fig. 9, Sumatra, holotype, ♀.
Brachyplatys pallifrons, 1863k: 55, pl. 4 figs. 10, 10a, Timor, 2 ♂, 10 ♀ syntypes.
Brachyplatys pauper, 1863k: 54, Java, Ternate, Celebes, 3 ♂, 3 ♀, 1 ? syntypes.
Brachyplatys radians, 1863k: 53, pl. 4 fig. 7, Celebes, 3 ♀ syntypes.
Coptosoma forsteni, 1863k: 49, pl. 4 figs. 4, 4a, Celebes, 3 ♀ syntypes.
Coptosoma marmoratum, 1868k: 48, pl. 4 fig. 3, Celebes, 1 ♂, 1 ♀ syntypes.
Coptosoma (sic!) modestum, 1863k: 47, pl. 4 fig. 1, Timor, holotype, ♂.
Coptosoma muelleri, 1863k: 49, pl. 4 fig. 5, Borneo, holotype ♀.
Coptosoma tondanense, 1863k: 48, pl. 4 fig. 2, Celebes, 2 ♀ syntypes.

Poseidon, 1864a: 30 (to *Cronion* Bergroth, 1891, new name), type-sp. *P. malayanus* Vollenhoven, 1864.

Poseidon malayanus, 1864a: 31; 1865c: 64, pl. 1 figs. 3—5 (to *Cronion*), Malacca, 1 ♂, 1 ♀ syntypes.

Tiarocoris sumatranus, 1863k: 51, pl. 4 figs. 6 ♂, 6 ♀, 6 ♂ a. Sumatra, 1 ♂, 1 ♀ syntypes.

Family Scutelleridae

Bolbocoris emarginatus, 1868d: 177, (to *Testrica*), Nova Hollandia (Australia), 2 ♂, 1 ♀ syntypes.

Callidea bilunulata, 1863k: 33, pl. 3 fig. 1 (to *Chrysocoris*), Sumatra, holotype, ♂.

Callidea bosschei, 1863k: 34, pl. 3 fig. 4, (to *Chrysocoris*), Banca, holotype, ♂.

Callidea caesar, 1863k: 21, pl. 2 fig. 1. (to *Calliphara*), Morotai, holotype, ♀.

Callidea celebensis, 1868d: 175 (to *Chrysocoris*), Celebes, 2 ♂, 4 ♀ syntypes, 1869c: 258, pl. 11 fig. c.

Callidea consul, 1863k: 36 (to *Chrysocoris*), Luçon, Manilla, 2 ♀ syntypes.

Callidea croesus, 1868d: 176 (to *Lampromicra*), Aru, Salawatti, Gebeh, 7 ♂, 7 ♀, syntypes; 1869c: 259, pl. 11. fig. e.

Callidea daedalica, 1868d: 176 (to *Chrysocoris*), patria ignota, 1 ♀, syntype.

Callidea ditissima, 1863k: 26, pl. 2 fig. 5 (to *Lampromicra*), Ambon, 1 ♂, 2 ♀ syntypes.

Callidea elongata, 1868d: 175 (to *Calliphara*), Salawatti, 1 ♂, 1 ♀ syntypes; 1869c: 257, pl. 11. fig. b.

Callidea eximia, 1863k: 20, pl. 1, figs. 8, 8a (to *Calliphara*), Sumatra, Ambon, Morotai, Ternate, 3 ♂, 6 ♀ syntypes.

Callidea fastuosa, 1863k: 26, pl. 2 fig. 6 (to *Lampromicra*), Ternate, 1 ♂, 3 ♀ syntypes.

Callidea gibbosa, 1863k: 30, pl. 2 figs. 10, 10a (to *Chrysocoris*), Java, 2 ♂, 3 ♀, syntypes.

Callidea gloriosa, 1863k: 35, pl. 3. fig. 5 (to *Lampromicra*), Java, 1 ♂, 1 ♀ syntypes.

Callidea hypopherythra, 1863k: 34, pl. 3 fig. 3 (to *Chrysocoris*), Borneo, holotype, ♂.

Callidea hypomelaena, 1863k: 33, pl. 3 fig. 2 (to *Chrysocoris*), Borneo, holotype, ♀.

Callidea latefasciata, 1868d: 175 (to *Lampromicra*), Salawatti, 2 ♀ syntypes; 1869c: 257, pl. 11 fig. d.

Callidea modesta, 1863k: 29 (to *Chrysocoris*), Sumatra, holotype, ♂.

Callidea puella, 1868d: 176 (to *Chrysocoris*), Cochinchina, 1 ♂ syntype.

Callidea quadrimaculata, 1863k: 23, pl. 2 figs. 2, 2a (to *Chrysocoris*), Ambon, 2 ♂, 1 ♀ syntypes.

Callidea schlegelii, 1863k: 24, pl. 2 figs. 3, 3a, 3b (to *Chrysocoris*), Halmheira, Bajoa, Ternate, 3 ♀ syntypes.

Callidea schwaneri, 1863k: 26, pl. 2 figs. 7, 7a, 7b (to *Chrysocoris*), Borneo, 1 ♂, 4 ♀ syntypes.

Callidea stalii, 1863k: 24, pl. 2 figs. 4, 4a, 4b (to *Calliscyta*), Timor, 1 ♂, 3 ♀ syntypes.

Callidea sumatrana, 1863k: 28, pl. 2 fig. 9 (to *Chrysocoris*), Sumatra, 5 ♂, 1 ♀ syntypes.

Callidea variabilis, 1863k: 22, pl. 1 fig. 9 (to *Chrysocoris*), Bali, 5 ♀ syntypes.

Cantao rudis, 1863k: 60, Isls. Kajoa & Morotai, 2 ♂, 6 ♀ syntypes.

Coleotichus fuscus, 1863k: 59 (to *Paracoleotichus*), Ceram, holotype, ♀.

Coleotichus pallidus, 1863k: 4, Adelaide (Australia), 1 ♀ syntype.

Eurygaster ligneus, 1863k: 39, Java, Celebes, 2 ♀ syntypes.

Hotea fusca, 1863k: 38 (to *Tylonca*), Java, holotype, sex ?

Libyssa westwoodii, 1868d: 175 (to *Calidea*), Zambesi, 1 ♂, 1 ♀, syntypes; 1869c: 256.

Pachycoris tigrinus, 1868d: 176 (to *Polytes*), Colombia, 1 ♂ syntype.

Poecilocoris aeneiventris, 1863k: 7, pl. 1 fig. 3 (to *Pachycoris*), "India Orientali" (New World species!). Not seen.

Scutellera pilosa, 1863k: 13 (as junior synonym of *S. amethystina* Germar).

Tetrarthria marginepunctata, 1863k: 13, pl. 1, fig. 6, a, b, c, d, Celebes, Sylhet (Bangla Desh), Java ?, 2 ♂ syntypes.

Tetrarthria tenebrosa, 1868d: 175, Amboina, 2 ♂, 1 ♀ syntypes; 1869c: 255, pl. 11 fig. a.

Suborder HOMOPTERA

Aphidoidea

Family Lachnidae

Dryobius riparius, 1862c: 91, 95, pl. 5 figs. 1—3 (to *Tuberolachnus*). Culemborg (Netherlands), 5 alate syntypes.

Auchenorrhyncha Family Cicadellidae

- Jassus apicalis*, 1862b: 83, Doorn (Netherlands), not seen.
Jassus longeciliatus, 1862b: 84, Noordwijk, Voorhout (Netherlands), 1 syntype (coll. Fokker).
Paropia vilis, 1862b: 81 (to *Megophthalmus*), Gliphoeve, Zutphen, (Netherlands), 2 syntypes.
Typhlocyba agathina, 1862b: 87 (to *Linnavuoriana*), Den Haag (Netherlands), holotype, ♂.
Typhlocyba aurantiaca, 1862b: 85 (to *Eurhadina*) Wassenaar (Netherlands), holotype, ♀.
Typhlocyba fastuosa, 1862b: 86 (to *Alebra*), Driebergen (Netherlands), not seen.
Typhlocyba medenbachii, 1879a: XII (nom. nud. to *Eurhadina*), Arnhem (Netherlands).

Sternorrhyncha Family Lecaniidae

- Lecanium rosarum*, 1862b: 94, Deventer (Netherlands), not seen.

ORDER COLEOPTERA

Vollenhoven's names were all traced in the *Coleopterorum Catalogus* of Junk & Schenkling for ascertaining the current combination of the species-group name. Meanwhile (i.e. since the publication of the respective parts of this catalogue) combinations may have been revised, but it is simply impossible to check this within a short period of time. Equally, lectotype designations may have been published of which we are unaware.

Family Apionidae

- Chalcocybebus*, 1866e: 225, incl. 2 species.
Chalcocybebus alboguttatus, 1866e: 226, Salawatti, 2 syntypes.
Chalcocybebus nitens, 1866e: 225, Waigeou, 1 syntype.

Family Attelabidae

- Apoderus anser*, 1865k: 162 (to *Cynotrachelus*), Timor, 5 syntypes.
Apoderus erythrogaster, 1865k: 165 (to *Compsapoderus*), Japan, holotype.
Apoderus niger, 1865k: 166, Gorontalo (Sulawesi), 2 syntypes.
Apoderus olor, 1865k: 161, Java, 2 syntypes.
Apoderus palliatus, 1865k: 162 (to *Paracynotrachelus*), Sumatra, Java, 5 syntypes.
Apoderus pardalis, 1865k: 164 (to *Paroplapoderus*), Japan, 2 syntypes.
Apoderus quadrillum, 1865k: 163 (to *Leptapoderus*), Java, 2 syntypes.

Family Bostrichidae

- Bostrichus iracundus*, 1869e: 10, pl. 1 fig. 7, 7a-b (to *Xylothrips*), Nossi-Bé (Malagasy), 2 syntypes.

Family Buprestidae

- Calodema johannae*, 1865b: 61, pl. 1 figs. 1, 2, Waigeou, 1 syntype.
Catocantha hemixantha, 1864c: 160, pl. 11 figs. 1, 2 (to *Megaloxantha*), Banca, holotype.
Chalcophora amabilis, 1864c: 163, pl. 11 fig. 5 (to *Chalcophorella*), Japan, syntypes. Not seen.
Chalcophora pyrostrictica, 1864c: 162, pl. 11 fig. 4 (to *Chrysodema*), Sumatra, 2 syntypes.
Chalcophora pyrothorax, 1864c: 162 (to *Chrysodema*), Borneo, 3 syntypes.
Chrysochroa ludekingii, 1864c: 161, pl. 11 fig. 3, Sumatra, 1 syntype.

Chrysobothris pulcherrima, 1864c: 164, Sumatra, Banca, 2 syntypes.

Psiloptera mayottensis, 1869e: 9, pl. 1 fig. 6, 6a (to *Polybothris*), Mayotte (Comores), syntypes. Not seen.

Family Cerambycidae

Batocera irregularis, 1871c: 220, pl. 9 fig. 3 (to *Abatocera*), Menado (Sulawesi), Sangir, at least 2 syntypes.

Batocera obligua, 1871c: 219, pl. 9 fig. 3, Buru, 3 syntypes.

Epipedocera perelegans, 1871b: 104, pl. 4 fig. 4, Timor, 2 syntypes.

Eurycephalus wieneckii, 1871b: 105, pl. 4 fig. 5 (to *Purpuricenus*), Timor, 1 syntype.

Leprodera felderii, 1871b: 109, pl. 5 fig. 9, Sumatra, 1 syntype.

Megacriodes guttatus, 1871b: 110, pl. 5 fig. 10 (to *Batocera*), Sumatra, 2 syntypes.

Phymasterna humeralis, 1869e: 10, pl. 1 fig. 1, 1a (to *Megalofrea*), Nossi-Bé (Malagasy), holotype.

Protemnemus rosenbergii, 1871b: 108, pl. 4 fig. 8, Doreh (West New Guinea), holotype. Not seen.

Tmesisternus isabellae, 1871b: 107, pl. 4 fig. 7, Salawatti, 2 syntypes.

Tragocerus heraldicus, 1871b: 106, pl. 4 fig. 6, New Guinea, holotype.

Family Cetoniidae

Chalcothea affinis, 1858c: 23, pl. 2 fig. 2, Borneo, holotype.

Clinteria dives, 1864c: 153, Borneo, Billiton, 2 syntypes.

Clinteria egens, 1864c: 152, Borneo, holotype.

Clinteria vidua, 1864c: 152, pl. 4 fig. 6, West coast of Sumatra, holotype.

Euryomia forsteni, 1864c: 156, pl. 10 fig. 4 (to *Glycyphana*), Tondano (Sulawesi), 1 syntype.

Euryomia quadriguttata, 1864c: 158 (to *Glycyphana*), Sumatra, Halmahera, Batjan, Morotai, 5 syntypes.

Euryomia regalis, 1864c: 157 (to *Glycyphana*), Tondano (Sulawesi), 1 syntype.

Euryomia sieboldii, 1864c: 158 (to *Glycyphana*), Japan, holotype.

Euryomia sumatrensis, 1864c: 157 (to *Glycyphana*), Sumatra, holotype.

Heterorhina infusata, 1864c: 151 (to *Smaragdesthes*), St. George del Mina (Ghana), 1 syntype.

Macroma flavoguttata, 1864c: 159, pl. 10 fig. 6, (to *Campsiura*), 2 syntypes. Lectotype, Krikken, 1977.

Macronota aciculata, 1864c: 153 (to *Penthima*), Java ("vrai habitat?"), holotype.

Macronota aurantiaca, 1858c: 26, pl. 2 fig. 5 (to *Taeniodera*), Sumatra, holotype not seen.

Macronota forsteni, 1858c: 24 (to *Mecinonota*), Tondano (Sulawesi), 1 syntype.

Macronota luctuosa, 1858c: 25, pl. 2 fig. 4 (to *Mecinonota*), Amboina (Moluccas), 2 syntypes.

Macronota ludekingii, 1864c: 154, pl. 10 fig. 1 (to *Eumacronota*), Fort de Kock (= Bukittinggi, Sumatra), 1 syntype.

Macronota suturalis, 1858c: 25, pl. 2 fig. 3 (to *Meroloba*), Sumatra, 2 syntypes.

Parachilia polleni, 1869e: 9, pl. 1 fig. 5, 5a-c (to *Heterosoma*), Nossi-Bé (Malagasy), holotype.

Schizorhina nigerrima, 1864c: 156 (to *Lethosesthes*), Morotai (Indonesia), 2 syntypes.

Schizorhina balteata, 1871f: 277, pl. 6 fig. 3 (to *Dilochrosis*), Waigeou, holotype.

Schizorhina sanguinolenta, 1864c: 155 (to *Sternoplus*), Tondano (Sulawesi), 1 syntype.

Trichius septemdecemguttatus, 1864c: 159, Japan, 1 syntype.

Family Cucujidae

Hectarthrum nodicorne, 1864c: 145, pl. 9 fig. 1, Borneo, holotype.

Family Curculionidae

Arachnopus frenatus, 1866e: 228, pl. 12 fig. 5, Salawatti, at least 1 syntype.

Arachnopus geometricus, 1866e: 227, pl. 12 fig. 4, Tondano (Sulawesi), 1 syntype.

Arachnopus persona, 1866e: 226, pl. 12 fig. 3, Waigeou, 2 syntypes.

Danae, 1864c: 16 (to *Rhinoscapha*), type-sp. *Danae lunulata* Vollenhoven, 1864 (monotypy).

Danae lunulata, 1864c: 166, pl. 12 fig. 2 (to *Rhinoscapha*), Morotai (Indonesia), holotype.

- Episomus stellio*, 1864c: 169, pl. 12 fig. 5, Sumatra, holotype.
Eupholus aurifer, 1864c: 167, pl. 12 fig. 3, Wahaai (South Ceram), holotype.
Eupholus bandanus, 1871b: 102, pl. 4 fig. 2, Banda (Moluccas), at least 5 syntypes.
Eupholus vilis, 1864c: 168 (to *Rhinoscapha*), Sumatra, at least 2 syntypes.
Macropterus verloreinii, 1871b: 101, pl. 4 fig. 1 (to *Esamus*), Atapoepoe (Timor) 1 syntype.
Pachyrhynchus forsteni, 1864c: 168, pl. 12 fig. 4, Ternate, Halmaheira, Sumatra, at least 7 syntypes.
Pachyrhynchus morotaiensis, 1864c: 169, Morotai (Indonesia), 2 syntypes.
Protoceraius laetus, 1866e: 228, pl. 12 fig. 1, Sulawesi, syntypes. Not seen.
Rhinoscapha batjanensis, 1864c: 164, Batjan (Moluccas), Kajoa (Sulawesi?), at least 7 syntypes.
Rhinoscapha dohrnii, 1864c: 165, pl. 12 fig. 1, Morotai (Indonesia), 5 syntypes.

Family Dynastidae

- Oryctes cristatus*, 1858c: 21, pl. 2 fig. 1, St. George del Mina (Ghana), holotype.
Stypotrupes candezei, 1866e: 222, pl. 11 figs. 1—4 (to *Ceratoryctoderus*), Celebes, 1 syntype.
Trichogomphus alcides, 1864c: 151, pl. 9, Borneo, 2 syntypes. Lectotype.
Trichogomphus simson, 1864c: 150, Sumatra, 3 syntypes. Lectotype.

Family Gyrinidae

- Dineutes bidens*, 1869e: 7, pl. 1 figs. 1, 2, Mayotte (Comores), at least 2 syntypes.

Family Lucanidae

- Dorcus forceps*, 1861d: 109, pl. 6 fig. 2 (to *Prosopocoilus*), Sumatra, 2 syntypes. Lectotype.
Dorcus niponensis, 1861d: 113, pl. 7 fig. 3 (to *Macrodercas*), Japan, 1 syntype.
Dorcus pilifer, 1861d: 112, pl. 6 fig. 4 (to *Serrognathus*), Japan, 2 syntypes.
Dorcus purpurascens, 1861d: 111, pl. 7 figs. 1, 2 (to *Serrognathus*), Sumatra, 3 syntypes.
Dorcus rectangulus, 1861d: 114, pl. 7 fig. 7 (to *Aegus*), Sumatra, 1 syntype.
Dorcus tragulus, 1861d: 113, pl. 7 figs. 4, 5, 6 (to *Prosopocoilus*), Sumatra, 2 syntypes. Lectotype, Bomans.
Eurytrachelus alcides, 1865i: 150, pl. 10 figs. 2, 3, Sumatra, 1 syntype.
Eurytrachelus rubrofemoratus, 1865i: 152, pl. 11 figs. 1, 2, Japan, syntype.
Gnaphaloryx miles, 1865i: 155, pl. 11 fig. 5, South Halmaheira and Gebeh (Indonesia), 2 syntypes.
Lucanus brookeanus, 1861d: 107, pl. 6 fig. 1 (to *Odontolabis*), Borneo, 2 syntypes. Lectotype, Bomans.
Lucanus lacordairei, 1861d: 105, pl. 5 fig. 1 (to *Odontolabis*), Sumatra, 1 syntype.
Lucanus ludekingii, 1861d: 105, pl. 5 fig. 2 (to *Odontolabis*), Sumatra, 2 syntypes.
Lucanus dejeani var. *nigra*, 1861d: 108 (to *Odontolabis*), no type-loc. given, 1 specimen (syntype) from Sumatra.

Family Melolonthidae

- Anomala bivittata*, 1869e: 8, pl. 1 fig. 4 (to *Prodoretus*), Nossi-Bé (Malagasy), holotype.
Parastasia atra, 1864c: 149, Amboina, 1 syntype.
Parastasia degenerata, 1864c: 147, Borneo, Sulawesi, Batjan, Morotai (Indonesia), 5 syntypes.
Parastasia ephippium, 1864c: 148, pl. 9 fig. 4, Sumatra, 2 syntypes.
Parastasia pileus, 1864c: 147, pl. 9 fig. 3, Borneo, Sumatra, Batjan, Halmaheira, 5 syntypes.
Patastasia vittata, 1864c: 149, Amboina, Buru, 6 syntypes.
Pleophylla unicolor, 1869e: 8, pl. 1 fig. 3 (to *Phylloserica*), Nossi-Bé (Malagasy), holotype.

Family Mordellidae

- Anaspis testacea*, 1854c: 70, Netherlands, syntypes.
Anaspis assimilis, 1854c: 70, Netherlands, syntypes.

Family Paussidae

Paussus ludekingii, 1872c: 82, Sumatra, 1 syntype (of 2).

Family Scaphidiidae

Apoderus spectrum, 1865k: 159, pl. 3 figs. (to *Diatelium*), Sumatra, 2 syntypes.

Family Scarabaeidae

Onthophagus schwaneri, 1864c: 146, pl. 9 figs. 2, 2a, Borneo, 2 syntypes.

Family Staphylinidae

Staphylinus pygmaeus, 1854c: 70 (to *Philonthus*), Netherlands, syntypes. Not seen.

Stenus roscidus, 1854c: 70, Netherlands, 1 syntype.

ORDER DIPTERA

Family Bombyliidae

Systropus blumei, 1863j: 8, pl. 1 fig. 4, Java, holotype, ♂.

Systropus tessellatus, 1863j: 9, Sumatra, holotype, ♂.

Family Calliphoridae

Calliphora nigribarbis, 1863j: 17, Japan, 4 ♀ syntypes. Lectotype, Van Helsdingen, 1980.

Silbomyia nitidissima, 1863j: 16, Tondano (Sulawesi), syntypes, 3 ♂, 1 ♀ (not 4 ♀). Lectotype, Crosskey, 1965.

Family Conopidae

Conops lugens, 1863 j: 10, pl. 1 fig. 5 (to *Physocephala*), Borneo, holotype, ♀ (not ♂!).

Conops niponensis, 1863j: 11, Japan, holotype, ♀ (not ♂!).

Family Dryomyzidae

Dryomyza gigas, 1863j: 18, pl. 1 fig. 7, Japan, 2 ♀ syntypes.

Family Rachiceridae

Antidoxion, 1863i: 6 (to *Rhachicerus* Walker), type-sp. *Antidoxion fulvicorne* Vollenhoven (monotypy).

Antidoxion fulvicorne, 1863i: 6, pl. 1 figs. 1—3 (to *Rachicerus*), Java, holotype, ♀.

Family Stratiomyidae

Ptilocera amethystina, 1858d: 92, Java, Celebes, 2 ♀ syntypes.

Ptilocera smaragdina, 1858d: 92, Menado (Sulawesi), 2 ♂ ♀ syntypes.

Family Syrphidae

Megaspis cingulatus, 1863j: 12, (to *Phytomyia*), Japan, 3 ♀, 3 ♂ syntypes.

Milesia apicalis, 1863j: 13, Java, holotype, ♂.

Milesia diardi, 1863j: 14, pl. 1 fig. 6, Borneo, 3 ♂ syntypes.

Milesia undulata, 1863j: 12, Japan, holotype, ♀.

Family Tachinidae

Rutilia pretiosa, 1863j: 15 (to *Formosia* subg. *Euamphibolia*), Ternate, ♀♂ syntypes. Lectotype, Crosskey, 1973.

ORDER HYMENOPTERA

Many of the Hymenoptera were described from the Netherlands; localities lacking country names are situated in the Netherlands. The families are arranged according to the usual grouping in Symphyta, Parasitica and Aculeata. In the non-Ichneumonid families records of type material mean that the specimens are in the Leiden museum. For the Ichneumonid types the presence in Leiden and Wageningen is specified. In a forthcoming paper K. W. R. Zwart will give more details concerning Ichneumonid types, including some lectotype designations.

SUBORDER SYMPHYTA

Family Argidae

Hylotoma flava, 1860e: 129 (to *Arge*), Japan, 2 ♀ syntypes. Not seen.

Hylotoma humeralis, 1860e: 129 (to *Arge*), Japan, holotype not seen.

Hylotoma microcephala, 1860e: 130 (to *Arge*), Java, 3 ♀ syntypes.

Hylotoma similis, 1860e: 128 (to *Arge*), Japan, 4 ♀ syntypes. Not seen.

Family Cephidae

Cephus elongatus, 1858b: 280 (to *Calameuta*), Sterkenburg near Driebergen; near Heemstede; 4 ♀, 1 ♂; 1 syntype from first locality seen.

Family Cimbicidae

Amasis sanguinea, 1878f: 154, pl. 9 (to *Corynis*), Morocco, holotype. Not seen.

Family Diprionidae

Lophyrus catocalus, 1858b: 276 (to *Gilpinia*), Groesbeek, 2 ♀, 2 ♂ syntypes.

Family Pamphiliidae

Lyda maculifrons, 1858b: 179 (to *Neurotoma*), near Utrecht, holotype, ♂. Not seen.

Lyda nigricornis, 1858b: 279 (to *Pamphilius*), near Den Haag, holotype, ♂.

Family Tenthredinidae

Dolerus busaei, 1858b: 277, Haarlem, 4 syntypes.

Emphytus majalis, 1869b: 121, pl. 3, near Utrecht. Holotype not seen.

Macrophya histrionica, 1878f: 155, surroundings of Baireuth, holotype, ♀. Not seen.

Macrophya klugii, 1869b: 124, Noord-Brabant; near Den Haag, 2 ♂ syntypes. Not seen.

- Nematus aquilegiae*, 1866b: 202, pl. 9 (to *Pristiphora*), Renkum, 4 syntypes.
Nematus catachloris, 1869b: 120, pl. 3, near Leyden. Type not seen.
Nematus consobrinus, 1871d: 237, pl. 10, Haarlem, 10 ♀, 1 ♂ syntypes. Not seen.
Nematus immaculatus, 1869b: 119, Schoten; near Rotterdam, syntypes. Not seen.
Nematus lugdunensis, 1871d: 243, pl. 11, dunes near Noordwijk, ♀ ♂ syntypes. Not seen.
Nematus pectoralis, 1867d: 223, surroundings of Utrecht, holotype. Not seen.
Nematus solea, 1870a: 59, pl. 1, Netherlands, from *Larix*, holotype, ♂. Not seen.
Nematus trimaculatus, 1862a: 69, pl. 4, Leiden, 2 syntypes (of 6).
Nematus vallator, 1858h: 191, pl. 12 (to *Pristiphora*), Leiden, 2 syntypes.
Nematus wttewaalli, 1862a: 65, pl. 4, Voorst; Utrecht; Velp; near Leyden; Sterkenburg near Driebergen; Ter Wadding between Leyden and Voorschoten; only one syntype present.
Phyllotoma pinguis, 1869b: 121, pl. 3 (to *Heterarthrus*), near Den Haag, holotype, ♀.
Selandria albomarginata, 1858b: 278 (to *Sciapteryx*), near Den Haag; near Utrecht, 3 syntypes. Not seen.
Selandria cereipes, 1873b: 13, pl. 3, Gelderland, "d. Roo, Velp", 3 syntypes seen (out of 12 ♀).
Selandria humeralis, 1869b: 122 (to *Blennocampa*), Gliphoeve, holotype, ♀.
Selandria phthisica, 1869b: 123, pl. 3 (to *Stromboceros*), Beekbergerwoud, holotype.
Selandria sixii, 1858b: 278, near Utrecht, holotype, ♀.
Selandria soror, 1869b: 123, Leyden, near Utrecht, syntypes. Not seen.

SUBORDER APOCRITA

Division Parasitica

Family Braconidae

- Alysia theodori*, 1878f: 174, pl. 11 fig. 3 (to *Phaenocarpa*), dunes of Loosduinen, holotype, ♀.
Laccophrys medenbachii, 1878f: 173, pl. 11 fig. 2 (to *Opius*?), Surroundings of Arnhem, holotype, ♀. Not seen.
Laccophrys villaenovae, 1876e: 243 (nom. nud.); 1878h: 172, pl. 11 fig. 1 (to *Opius*), Naaldwijk; Zeeland; ♂ ♀ syntypes. Not seen.
Macrocentrus flavus 1878h: 54, pl. 34 fig. 3, Glogau (Poland), ♀ ♂ syntypes. Not seen.
Mesora analis, 1878f: 175, pl. 11 fig. 4 (to *Dacnusa*), Biggekerke in Zeeland, holotype, ♂. Not seen.
Microdus compeditus, 1876e: 243 (nom. nud.), near Venlo; specimens not seen, synonymized by Vollenhoven (1878f: 173) with *Agathis rugulosus* (Nees, 1834).
Phylax aestivalis, 1858b: 282 (to *Aleiodes*), near Den Haag, holotype, ♀. Synonymized by Vollenhoven (1873e: 193) with *Rogas dissectus* Nees, 1834.
Polemon albinus, 1873f: 219 (to *Coelinus*), near Vogelenzang. Type not seen.
Rogas pubescens, 1879a: XXVI (nom. nud.), St. Jansberg, Mook.
Vipio insularis, 1873f: 218, pl. 9 fig. 5 (to *Agathis*), near Koudekerke in Zeeland; holotype, ♀. Not seen. Synonymized by Vollenhoven (1878g: 46) with *Agathis syngenesiae* Nees, 1814.

Family Cynipidae

- Aulax albinervis*, 1869b: 126. Driebergen, holotype, ♀. Not seen.

Family Diapriidae

- Loxotropa sabuleti*, 1879d: 62, pl. 40 fig. 2 (to *Spilomicrus*), Netherlands. Type not seen.
Spilomicrus major, 1879d: 63, pl. 40 fig. 7, Burgdorf (Switzerland), Den Haag, 2 ♂ syntypes. Not seen.

Family Eucolidae

- Eucoila effluens*, 1869b: 126, pl. 3, near Utrecht, holotype ♀. Not seen.
Eucoila inflata, 1867d: 224, pl. 10, figs. 2—3, surroundings of Utrecht; Driebergen, 2 syntypes. Not seen.

Family Ichneumonidae

- Agrothereutes batavus*, 1873f: 209, pl. 9 fig. 1, Zuid-Holland, holotype, ♀. (Wageningen).
- Agrothereutes destitutus*, 1879f: 58, pl. 37 fig. 4, no type locality mentioned, holotype, ♀. Not seen.
- Anomalon bucephalum*, 1858b: 281 (to *Heteropelma*), Walcheren and Warmond, 4 ♂ syntypes (Leiden and Wageningen). Synonymized by Vollenhoven (1876e: 237) with *Anomalon amictum* F.
- Anomalon melanocneme*, 1878f: 168, pl. 10 fig. 5, near Montpellier (France), holotype, ♀. Not seen.
- Aptesis longicauda*, 1873f: 210, Wort-Rhede in Gelderland, holotype, ♀ (Wageningen).
- Atractodes spiniger*, 1876e: 239 (nom. nud.); 1878f: 171, pl. 10 fig. 8, near Leyden, holotype, ♂. Not seen.
- Bassus monticola*, 1875e: 4, pl. 1 fig. 9 (to *Sussaba*), Switzerland, holotype (sex not given). Not seen.
- Bassus quadriguttatus*, 1873f: 211, Leyden, holotype, ♀ (Wageningen).
- Coleocentrus abiae*, 1873f: 215, pl. 9 fig. 3 (to *Perispuda*), no type-locality mentioned (in the Netherlands), holotype, ♂ (Wageningen).
- Coleocentrus sixii*, 1873f: 216, pl. 9 fig. 4, near Utrecht, holotype, ♂. Not seen.
- Colpotrochia affinis*, 1875f: 12, pl. 8 fig. 2, Arnhem, holotype (sex not given). Not seen.
- Cremastus balteatus*, 1878f: 169, pl. 10 fig. 6, Breda, holotype, ♂. Not seen.
- Cremastus cabalisticus*, 1876e: 239 (nom. nud.). In 1878f: 169 Vollenhoven states that the specimen does not belong to a new species, nor is it a *Cremastus*. No specimen seen.
- Cremastus sabulosus*, 1876e: 239 (nom. nud.); 1878f: 170, pl. 10 fig. 7, near Scheveningen, 2 ♂ syntypes. Not seen.
- Crypturus niger*, 1878f: 158, pl. 9 fig. 3, (Southern) France, holotype, ♂ (?). Not seen.
- Eclytus semiluctuosus*, 1878h: 51, pl. 32 fig. 5, near Driebergen and Roozendaal, syntypes (sex not given) (1 syntype Leiden; heavily damaged).
- Ephialtes melanomerus*, 1878c: 48 (to *Dolichomitus*), Java, holotype, ♀ (Leiden).
- Euceros unifasciatus*, 1876e: 229 (nom. nud.); 1878f: 159, near The Hague, Leyden, [var. near Breda], 2 ♀ syntypes. Not seen. In 1878h: 53 Vollenhoven states that it might be a variety of *Euceros egregius*.
- Exetastes cimbicis*, 1858b: 281, Zwammerdam ex *Cimbex aenea* (1858a: 244) (to *Perispuda*), ♂ + ♀ syntypes (1 ♂, 1 ♀ Wageningen, 2 specimens Leiden).
- Exochus semilividus*, 1875f: 13, pl. 8 fig. 11, Switzerland, holotype (sex not given). Not seen.
- Exophanes* [sic !] *fulvescens*, 1875e: 5, pl. 2 fig. 5, Rotterdam, holotype ♀. Not seen.
- Glypta elegans*, 1873f: 214, pl. 9 fig. 2, Beverwijk, 2 ♂ syntypes (Wageningen).
- Lissonota cruenta*, 1858b: 281, near Brummen (1858a: 241), 3 ♀ syntypes (2 Wageningen, 1 Leiden). Synonymized with *Lissonota lateralis* Grav. bij Vollenhoven 1873e: 178.
- Notopygus fulvipes*, 1878h: 50, pl. 31 fig. 5, no type locality given, probably from Sweden, holotype (sex ?). Not seen.
- Notopygus minkii*, 1878h: 49, pl. 31 fig. 4, no type locality given, probably from Germany, holotype, ♀. Not seen.
- Ophion monostigma*, 1879f: 62, pl. 39 fig. 8 (to *Enicospilus*), no type locality given, holotype (sex ?). Not seen.
- Ophion tournieri*, 1879f: 61 (to *Enicospilus*); in 1878g: pl. 28 fig. 7 figured as *Ophion repentinus* Hlg., type locality not given, probably near Geneva (Switzerland), holotype ♂. Not seen.
- Ophion unicallosus*, 1878f: 167, pl. 10 fig. 4 (to *Enicospilus*), Espagne (Spain), holotype ♀. Not seen.
- Panicus ornatus*, 1973f: 218 (to *Netelia*), Drever in Groningen, holotype, ♀ (Wageningen).
- Perilissus singularis*, 1878h: 52, pl. 32 fig. 8, near Rotterdam, holotype, ♂ (Leiden).
- Phidias*, 1878f: 164 (= *Diacritus* Foerster, 1868), type-sp. *Phidias aciculatus* Voll., 1878 (monotypy). Preoccupied by *Phidias Rafinesque*, 1815.
- Phidias aciculatus*, 1878f: 165, pl. 10 fig. 2 (to *Diacritus*), Angleterre (England), holotype, ♀. Not seen.
- Phytodietus exareolatus*, 1876e: 236 (nom. nud.); 1878f: 163 (as *Phytodictus* [sic !]), pl. 9 fig. 5, Voorst in Gelderland, holotype, ♀. Not seen.
- Pimpla basalis*, 1879e: 148 (to *Lissopimpla*), Sumatra, holotype, ♂ (Leiden).
- Pimpla caligata*, 1877f: 34, pl. 21 fig. 8, near Scheveningen, holotype, ♂. Not seen.
- Pimpla elegans*, 1879e: 147 (to *Xanthopimpla*), Java, holotype, ♀ (Leiden).
- Pimpla laevadorsum*, 1873f: 213 (to *Scambus*), Voorst, holotype, ♀ (Wageningen).
- Pimpla sagrae*, 1878b: LXXVI (nom. nud.); 1879e: 149 (to *Sericopimpla*), Buitenzorg, Java, lectotype ♀ (Townes et al. 1961), 5 ♂ ♀ syntypes (of 6) (Leiden).

- Pimpla transversalis*, 1879e: 146 (to *Xanthopimpla*), Sumatra, Borneo, Timor, Thibet, lectotype ♀ (Townes et al., 1961) from Sumatra, 1 ♂, 2 ♀ syntypes (Leiden).
- Pimpla vincta*, 1873f: 212, Holland, Zeeland, Utrecht, Gelderland (Provinces), 1 ♀ syntype (Wageningen).
- Pimpla zebra*, 1879e: 147 (to *Theronia*), Ambarawa, Java, holotype, ♀ (Leiden).
- Platylabus pictus*, 1878f: 157, pl. 9 fig. 2, surroundings of Montpellier (France), holotype, ♂. Not seen.
- Rhyssa bernsteinii*, 1879e: 138 (to *Myllenyxis*), Salawatti or Waigeou (Indonesia) (label destroyed during transport, according to Vollenhoven), holotype, ♀ (Leiden).
- Rhyssa doreica*, 1873c: 69, pl. 4 fig. 3 (to *Lytarmes*), Dorey, New Guinea, holotype, ♀ (Leiden).
- Rhyssa flaviceps*, 1879e: 139 (to *Certonotus*), Aru (Indonesia), lectotype ♀ (Townes et al., 1961), 3 ♀ syntypes (Leiden).
- Rhyssa fractinervis*, 1873c: 67, pl. 4 fig. 1, surroundings of Auckland, New Zealand, holotype, ♀ (Leiden).
- Rhyssa fulva*, 1879e: 136 (to *Lytarmes*), Obi (Indonesia), holotype, ♂ (Leiden).
- Rhyssa laniaria*, 1873c: 68, pl. 4 fig. 2 (to *Megarhyssa*), Amboine (= Ambon) (Indonesia), holotype, ♀ (Leiden).
- Rhyssa mülleri*, 1879e: 140 (to *Myllenyxis*), Java, holotype, ♀ (Leiden).
- Scolobates corrallinus*, 1873f: 211, Wikkenberg near Schalkwijk, 4 ♀ syntypes (Wageningen) (of 5).
- Scolobates marshalli*, 1878f: 166, pl. 10 fig. 1, Pyrenées (France), holotype, ♂. Not seen.
- Syene*, 1878b: LXXVI (= *Echthromorpha* Hlg., 1868), no species included, type-sp. *Cryptus notulatorius* F. (= *E. agrestoria notulatoria*), designated by Townes, 1960.
- Trichomastix*, 1878f: 160 (= *Bioblapsis* Foerster, 1868), type-sp. *Trichomastix polita* Voll., 1878 (monotypy).
- Trichomastix polita*, 1878f: 161, pl. 9 fig. 4 (to *Bioblapsis*), Scheveningen, holotype, ♀. Not seen.

Family Proctotrupidae

Proctotrupes sixianus, 1879a: XIII, Netherlands, Type not seen.

Family Pteromalidae

- Hetroxys gribodii*, 1878f: 176, pl. 11, North Italy, 2 ♀ syntypes. Not seen.
- Lagynodes pallipes*, 1873e: 205 (nom. nud.); 1876e: 253 (nom. nud.). Synonymized by Vollenhoven (1876e: 249) with *Theocolax formiciformis* Westwood. No specimens seen from "Leyden".

DIVISION ACULEATA

Family Apidae

- Bombus senex*, 1873g: 229, pl. 10, Sumatra, holotype, ♀.
- Nomada batava*, 1858b: 283, near Leiden, holotype not seen, may be a specimen under *Nomada goodeniana* Kirby, 1802.

Family Dryinidae

- Dryinus spectrum*, 1874c: (LXVI) (nom. nud.); 1874b: 159, figs. 3—4, from "Vogelzang" (= Vogelenzang), holotype, ♀.
- Gontiozus tibialis*, 1876e: 253 (nom. nud.); 1878f: 177, pl. 11, near Den Haag, one of the 2 syntypes seen.

ORDER LEPIDOPTERA

For the family classification of the Papilionoidea Kristensen (1976) has been followed. The family classification of the other Lepidoptera is in conformity with

the dictionary of Laithwaite et al. (1975). No attempt has been made to indicate the genera the taxa described by Snellen van Vollenhoven are at present supposed to belong to, as there is no general agreement on the generic classification of many families. Most species-group names of the list below can be found in the Lepidopterorum Catalogus, where further references are given.

Family Agaristidae

Ophthalmis bernsteinii, 1863f: 132, pl. 9 fig. 1, Morotai, holotype, ♂.

Family Arctiidae

Crambomorpha (?) *aurora*, 1873h: 246, pl. 12 fig. 2, Salawatti. Type not seen.

Gnophria (?) *ceramensis*, 1873h: 246, pl. 12 fig. 1, Ceram, holotype, ♂ (?).

Hypsa orbona, 1863f: 137, pl. 9 fig. 4, Halmaheira, Morotai, 4 syntypes.

Leptosoma assimile, 1863h: 39 (to *Nyctemera*, the following species as well), Java, 2 ♂ syntypes.

Leptosoma clathratum, 1863h: 48, Amboina, holotype, ♀.

Leptosoma flavescens, 1863h: 46, Sumatra, holotype, ♀.

Leptosoma herklotsii, 1863h: 39, Java. Type not seen.

Leptosoma inconstans, 1863h: 47, Java, Borneo, 4 ♂, 5 ♀ syntypes.

Leptosoma luctuosum, 1863h: 42, Batjan, holotype, ♂.

Leptosoma ludekingii, 1863h: 49, Sumatra. Type not seen.

Leptosoma macklotti, 1863h: 50, Amboina, holotype, ♀.

Leptosoma mülleri, 1863h: 41, Sumatra, 2 ♀ (?) syntypes.

Leptosoma noviespunctatum, 1863h: 42, Java, 3 ♀ syntypes.

Leptosoma nubecula, 1863h: 45, Java, 2 ♂ syntypes.

Leptosoma pallens, 1863h: 45, Java, holotype, ♂.

Leptosoma quadriguttatum, 1863h: 40, Java, 2 ♂ syntypes.

Numenes trigonalis, 1863f: 140, pl. 10 fig. 1, Sumatra, 2 ♀ syntypes.

Numenes virginalis, 1863f: 142, Sumatra, holotype, ♀.

Spilosoma roseiventer, 1863f: 143, Japan. 2 ♂, 1 ♀ syntypes.

Family Elachistidae

Atteva apicalis, 1863f: 139, pl. 9 fig. 5, Java, 2 syntypes.

Atteva basalis, 1863f: 140, pl. 9 fig. 6, Morotai, 7 syntypes.

Family Geometridae

Milionia flammula, 1863f: 134, pl. 9 fig. 2, Nova Guinea, holotype, ♂ (?).

Milionia fulgida, 1863f: 133, pl. 8 fig. 4, Java, 1 ♂, 1 ♀ syntypes.

Family Lymantriidae

Lymantria (*Liparis*) *hilaris*, 1863f: 143, pl. 10 figs. 2, 3, Sumatra (interior), 1 ♂, 3 ♀ syntypes.

Family Noctuidae

Phyllodes eyndhovii, 1859b: 86, pl. 6, Java. Type not seen.

Phyllodes verhuellii, 1858f: 159, pl. 8, Java, holotype, ♂.

Family Nymphalidae

Acraea dammi, 1869e: 12, pl. 2 fig. 4, Nossi-Bé (Malagasy), holotype, ♂.

- Adolias agnis*, 1862f: 202, pl. 12 fig. 2; 1862h: 273, Java, 1 ♀ syntype.
Adolias apicalis, 1862f: 186, pl. 10 fig. 1; 1862h: 270, Borneo, holotype, ♂.
Adolias apsarasa, 1862f: 198, pl. 11 fig. 3; 1862h: 272, Borneo, holotype, ♂.
Adolias bipunctata, 1862f: 191, pl. 10 fig. 4; 1862h: 271, Borneo, holotype, ♂.
Adolias blumei, 1862f: 205, pl. 12 figs. 3, 4; 1862h: 273, Java, Sumatra (Padang), syntypes, probably several specimens.
Adolias clathrata, 1862f: 205, pl. 12 fig. 5; 1862h: 273, Borneo, holotype, ♂.
Adolias diardi, 1862f: 188, pl. 10 fig. 2; 1862h: 270, Borneo, holotype, ♂.
Adolias gandarva, 1862f: 199, pl. 11 fig. 4; 1862h: 272, Java, 1 ♂, 3 ♀ syntypes.
Adolias indras, 1862f: 194, pl. 11 fig. 2; 1862h: 271, Borneo, 1 ♀ syntype.
Adolias ludekingii, 1862f: 189, pl. 10 fig. 3; 1862h: 270, Padang (Sumatra), holotype, ♀.
Adolias octogesima, 1862f: 193, pl. 10 fig. 5, pl. 11 fig. 1; 1862h: 271, Java, Borneo, 1 ♀ syntype.
Adolias pardalis, 1862f: 197, pl. 11 fig. 5; 1862h: 272, Java, 1 ♂ syntype.
Adolias surjas, 1862f: 200, pl. 12 fig. 1; 1862h: 272, Java, holotype, ♀.
Adolias varuna, 1862f: 195, pl. 10 fig. 6; 1862h: 271, Java, Borneo, 2 ♂, 1 ♀ syntypes.
Charaxes cognatus, 1861e: 159, pl. 9 figs. 1, 2, Moluques, holotype, ♂.
Charaxes concha, 1861e: 162, pl. 10 figs. 1, 3, Java, Padang (Sumatra), 2 ♂, 1 ♀ syntypes.
Charaxes rayi, 1861e: 161, pl. 9 fig. 3, pl. 10 fig. 2, Ambon, holotype, ♂.
Drusilla anableps, 1860a: 40, pl. 1 fig. 3, pl. 2 fig. 1, Otaheiti, holotype, ♂.
Drusilla artemis, 1860a: 37, pl. 1 figs. 1, 2, Nieuw-Guinea, holotype, ♂.
Drusilla dioptrica, 1860a: 38, pl. 2 figs. 2, 3, Nieuw-Guinea, holotype, ♂.
Drusilla diops, 1863f: 131, pl. 8 fig. 3, Morotai, Halmaheira, 2 ♂ syntypes.
Euploea mesocala, 1873h: 244, pl. 11 figs. 1, 2, Waigeou, 1 ♂, 1 ♀, syntypes.
Euploea superba, 1866c: 209, pl. 10 fig. 1, Gorontalo (Sulawesi), 6 ♂ syntypes.
Idea diardi, 1860a: 44, pl. 2 fig. 4, Borneo, 2 ♂, 2 ♀ syntypes.
Idea tondana, 1860a: 41, pl. 4, Tondano (Sulawesi), 1 ♂, 1 ♀ syntypes.
Melanitis stellaris, 1861e: 159, pl. 8 fig. 3, Nouvelle Guinée, holotype, ♀.
Minetra tigrina, 1866c: 210, pl. 10 fig. 2, Salawatti, 2 ♂ syntypes.
Mynes mulderi, 1863f: 129, pl. 8 figs. 1, 2, Batjan, Halmaheira, 3 ♂ syntypes.
Vanessa royeri, 1861e: 157, pl. 8 figs. 1, 2, Nouvelle Guinée, holotype, ♀.

Family Papilionidae

- Papilio trogon*, 1860b: 69, pl. 6 figs. 1, 2, Sumatra, 2 ♂ syntypes.

Family Pieridae

- Iphiaes felderi*, 18651: 53, pl. 6 figs. 2, 3, Halmaheira, Morotai, 1 ♂, 1 ♀ syntypes.
Pieris affinis, 18651: 40, pl. 5 fig. 2, Celebes sept., holotype, ♂.
Pieris amalia, 18651: 23, pl. 3 fig. 6, Sumatra, Banca, 1 ♂ syntype.
Pieris candida, 18651: 11, pl. 3 fig. 2, Batjan. Type not seen.
Pieris chrysomelaena, 1866a: 57, pl. 1 figs. 1, 2, Kajoa, holotype, ♂.
Pieris chrysorrhoea, 18651: 6, pl. 2 fig. 4, Sumatra, holotype, ♂.
Pieris cornelia, 18651: 5, pl. 2 fig. 2, Borneo, holotype, ♂.
Pieris dice, 18651: 39, pl. 4 fig. 7, Nova Guinea, Waigeou, 2 ♂, 1 ♀ syntypes.
Pieris elisa, 1869e: 12, pl. 2 fig. 3, Mayotte (Comores), 1 ♂, 1 ♀ syntypes.
Pieris emma, 18651: 24, pl. 4 fig. 2, Batjan, 2 ♀ syntypes.
Pieris fatime, 1866a: 59, pl. 2 figs. 1, 2, Celebes, holotype, ♀.
Pieris haemorrhoea, 18651: 10, pl. 2 fig. 5, Banca, 1 ♂, 1 ♀ syntypes.
Pieris hagar, 18651: 38, pl. 4 fig. 6, Padang (Sumatra), holotype, ♂.
Pieris herodias, 18651: 14, pl. 3 fig. 4, Galela (Halmaheira), 1 ♂, 1 ♀ syntypes.
Pieris hester, 18651: 24, pl. 4 fig. 1, Nova Guinea, 2 ♀ (?), syntypes.
Pieris poecilea, 18651: 13, pl. 3 fig. 3, Halmaheira, Morotai, 1 ♂, 2 ♀ syntypes.
Pieris rosenbergii, 18651: 11, pl. 2 fig. 6, pl. 3 fig. 1, Celebes sept., 3 ♂, 2 ♀ syntypes.
Pieris sulphurea, 18651: 32, pl. 4 fig. 4, Insulae Moluccae, 2 ♂, 1 ♀ syntypes.
Pieris zoe, 18651: 37, pl. 4 fig. 5, Batjan, holotype, ♂.

- Pontia lignea*, 1865l: 4, pl. 2 fig. 1a, b, Boné, Gorontalo (Sulawesi), 3 ♂ syntypes.
Terias impura, 1865l: 70, pl. 7 fig. 5, Timor, holotype, 1 ♂ (?).
Terias tominia, 1865l: 66, pl. 7 fig. 4, Celebes sept., 1 ♂, 2 ♀ syntypes.
Thestias ludekingii, 1860d: 125, Sumatra (interior), holotype, ♂.
Thestias reinwardtii, 1860d: 126, Moluques, holotype, ♂.

Family Pyralidae

- Deiopeia occultans*, 1869e: 13, pl. 2 fig. 5, Nossi-Bé (Malagasy), holotype, ♂.

Family Saturniidae

- Saturnia insularis*, 1862g: 335, pl. 14 fig. 1, Java, Sumatra, 4 ♂ syntypes.

Family Zygaenidae

- Agalope westwoodii*, 1863f: 136, pl. 9 fig. 3, Japan, holotype, ♂.
Chalcosia candida, 1863f: 135, Sumatra, 2 syntypes.
Leptosoma arcuatum, 1863h: 45, Java, 2 ♂ syntypes.
Leptosoma marginale, 1863h: 43, Java, holotype, ♂.

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Figs. 1—5. *Adolias* species described by Snellen van Vollenhoven, after his original water colours. The names of Snellen van Vollenhoven are followed by the names of the taxa (in brackets) Snellen van Vollenhoven's species are currently considered to belong to.

1. *Adolias diardi*, holotype (subspecies of *Euthalia cocyntina* Horsfield). 2. *Adolias ludekingii*, holotype (*Euthalia cocyntina cocyntina* Horsfield). 3. *Adolias bipunctata*, holotype (subspecies of *Euthalia monina* Fabricius). 4. *Adolias octogesima*, ♂ (*Euthalia alpheda alpheda* Godart; the female of *A. octogesima* is considered to be the same as *Euthalia monina salia* Moore). 5. *Adolias varuna* (subspecies of *Tanaecia litala* Moore).

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* Een sterretje duidt aan een naam nieuw voor de wetenschap

* An asterisk denotes a name new to science

The articles by Bouček, Watsham and Wiebes (on p. 232) and Krikken, Van Achterberg, Van Doesburg, De Jong & Zwart (on p. 263) have their own index.

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